ALL ABOUT

GOLD, GEMS, AND PEARLS,

IN CEYLON.

COMPILED

BY THE PUBLISHERS,

FROM EVERY AVAILABLE AUTHORITY.

WITH SPECIAL REFERENCE TO THE ESTABLISHMENT OF A GOLD-MINING INDUSTRY, AS WELL AS THE EXTENSION OF THE PRESENT GEM-DIGGING ENTERPRISE, IN THE COLONY.

COLOMBO:
A. M. & J. FERGUSON.

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Ceylon! Ceylon! 'tis nought to me
  How thou wert known or named of old,
As Ophir, or Taprobane,
  By Hebrew king, or Grecian bold:—

To me thy spicy-wooded vales,
  Thy dusky sons, and jewels bright,
But image forth the far-famed tales—
  But seem a new Arabian night.

And when engirdled figures crave,
  Heed to thy bosom's glittering store—
I see Aladdin in his cave;
  I follow Sindbad on the shore.

—Miss Jewsbury.

INTRODUCTORY NOTE.

— where the gorgeous East, with richest hand,
Showers on her kings barbaric pearl and gold.

When, at the request of several colonists, we began to reprint the information at our command in reference to the existence of "Gold in Ceylon," we had no intention of travelling beyond that particular subject or of publishing a pamphlet of more than fifty pages. By degrees, however, information grew on our hands which appeared to have a direct bearing on the best means of guiding prospectors to the development of a gold-mining industry in Ceylon, and it seemed a pity not to give it a place. Our attention was next called to the importance of the Gem-digging Enterprise as carried on, chiefly in the Sabaragamuwa district; to the splendid opportunity presented for the development of this industry by means of European capital and appliances; and to the fact that very little was known in England or even among colonists here respecting Ceylon gems or the primitive means adopted by the Sinhalese for their discovery and collection.

To make the *brochure* complete, we next resolved to reprint information respecting the Minerals and Geology generally of the island; giving special papers on Plumbago, the only mineral of commercial importance so far included in our export trade; and finally, in order to round off the list of precious things for which Lanka and Serendib have been famous from time immemorial, we have added the story of our "Pearl Fisheries" with all the the facts and figures at our disposal.

We regret that, from the circumstance of the work gradually growing as the printing went on, a systematic compilation could not be attempted, but we trust the full Index will enable every one to find what he wants, and that this little book may be of interest as well as of some service to all anxious to establish a Gold-mining industry, and to extend the Gem-digging enterprise in this

Utmost Indian isle, Taprobane.

THE PUBLISHERS.

COLOMBO, 24th June, 1881.

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GOLD IN CEYLON.

GOLD MINING IN INDIA—WHY NOT IN CEYLON?

At the end of 1880, the aggregate capital of the several Gold-mining Companies connected with Southern India amounted to a couple of millions sterling. By this time, we suppose, this amount is considerably exceeded. Fortunes have already been made through the rise in value of auriferous land, as well as through the rise, more or less speculative, in the shares of the more favoured Companies. We are credibly informed that a gentleman formerly connected with Messrs. Delmege, Reid & Co., Galle, but now for several years engaged in mercantile business on the Coast of India, has put together a tidy fortune exceeding £20,000 sterling through the rush into "gold-mining"; and the very latest news—enough to make the Ceylon owners of auriferous property stare—is to the effect that a piece of land in the Wynaad, bought for R500 not many months ago, has just been sold for £15,000 cash. This sale is on account of two gentlemen, one of whom is at present connected with banking in Ceylon.

All this no doubt will be regarded as very tempting news by many in Ceylon, and all the more so, as we believe there is as good *prima facie* evidence of profitable quartz reefs existing in our hill-country as there was in regard to Wynaad when gold-mining Companies began to be established for that region. The time has therefore come for practical systematic investigation in Ceylon conducted by men who know their business as gold-miners and quartz diggers guided as far as is necessary by the scientific geologist. Some time ago we mentioned that gentlemen connected with the Lanka Plantations Company in London were interesting themselves in the question of "Gold in Ceylon," and that under their auspices, possibly, Mr. Brough Smyth might be asked to visit and report. Already, we believe, Mr. Smyth has given an opinion favourable to the probability of the gold-yielding reef cropping up in our hill-country, and it seems to us likely that all that this gentleman would have to do would be to set practical miners to

all the information and much of the discussion to which it has given rise. The result seems to be that Ceylon numbers Gold amongst her Mineral products, altho' not in quantities to render the search for it remunerative, or pleasant in such a climate as ours. The scene of the Diggings is in the bed of the Maha Oya whose sources and tributaries rise amidst the Dolosbage and Kadugannawa Groups of Coffee Estates: while not far from its embouchure in the neighbourhood of Negombo are tracts of Cocoanut and Cinnamon Cultivation. Curiously enough Girooella in the neighbourhood of the Diggings is the spot where Dr. Davy closed those journeyings, one of the results of which he authoritatively declared to be that no Gold existed in Ceylon. Bennett combatted this opinion. Dr. Gygax, it appears, found traces of Gold in Saffragam, and Dr. Kelaart stated recently that some grains had been discovered at Nuwara Eliya. To the latter gentleman we owe the information that Mr. Hopkins, a great authority in Gold Mining, touched at Galle and pronounced it as his opinion that though Gold might be found in small quantities no profitable Diggings could be expected. The "practical" Diggers entertain a different opinion, but the results hitherto are in favour of the less sanguine view. Disease has already attacked the Diggers and within the last few days rains have set in which will probably put a sudden stop to their operations. The Maha Oya and many other rivers in Ceylon very nearly resemble those of Australia—their beds, which are nearly dry in the hot season, filling up rapidly when rains fall as they do in the Hills at the rate of 5 or 6 inches in a day. The result of a "prospecting" tour towards the Hills on the part of Mr. T. Power, accompanied by Dr. Ellery and Bradley, seems to be that auriferous sand been found in the bed of the Hingool Oya, a tributary of the Maha Oya, and in the bed of the Main Stream about 40 miles up from the original discovery near Girooela; but we hear of no nuggets even at that near point to the Hilly Ranges. Further search must now be stopped by the heavy rains which have fallen. In view of the result to which the search for Gold seems tending, Government have rendered themselves the subjects of much jocular remark by the issue of solemn Proclamations vindicating the rights of the Crown and forbidding all persons to dig without a License—a Special Gold Commissioner being appointed to grant such Licenses at 10s a month. No Licenses have as yet been applied for we believe.

Passing over details, we come to the next summary—April 11th—by which time the excitement and exploration (in consequence of heavy rain and bad fever) had pretty well subsided —and accordingly here is what was said:—

We cannot yet number Gold amongst our exports, the furor consequent on the discovery of flakes of metal in the Maha Oya having subsided as rapidly as it arose. The duty of a public Journalist in such a case is to collect and lay before his readers all the information possible. This we did, taking no oversanguine view of the possible result but the contrary. We are therefore not open to the animadversions of certain sage writers who can preach very wisely to those who do not need their teaching. The fact has been established that Gold exists in the rivers of Ceylon, but sickness and the rains have prevented such a thorough search as would settle definitively the question of quantity. A thorough exploration of the Country with reference not only to Gold but to other Minerals and Metals is a highly desireable measure and one more worthy of Government than the issue of repressive Proclamations.

Previous to this, the *Observer* had to take special pains to reassure the planters, many of whom are described as in an anxious state of suspense, lest gold-digging should be established as a rival to coffee-planting. They seem to have been greatly relieved when sickness drove the explorers away with so poor a return in

actual value for their labours that no one had the courage to renew the search in the next dry season. Subsequently on June 22nd the following reference was made:—

It is rumoured that Gold in considerable quantity has been discovered in Nuwara Eliya.

But there again the digging was soon after discontinued, and at a time when coffee planting was comparatively in its infancy and offered all possible scope for energy and capital, the enquiry after gold, as might be expected, dropped out of view.

Now what we wish to point out is that in 1854 there was no idea of working on the reef. Quartz crushing at that time was comparatively unknown even in Australia. Deep shafts running down hundreds of feet into the bowels of the earth, such as we visited in 1869 at Ballarat, were not thought of fifteen years previously. Surface washing and pit digging alone commanded attention, and it is no wonder, therefore, that Ceylon was abandoned as an unprofitable field for such operations. Since then it is not too much to say, that the work of gold-mining has been entirely revolutionized, and it is the application of modern machinery for blasting, crushing and extracting gold from quartz that alone renders it possible to mine with profit in Southern India. There, as in Ceylon, the hopes of all concerned depend on quartz reefs, and we have abundance of evidence to shew that the work of the practical miner in our local auriferous region would probably be crowned with success. Not in the Southern, but along the western slopes of the Central Province—in the Kadugannawa, Kegalla and Dolosbage districts *par excellence*—ought the trial to be made. Mr. Brough Smyth in his official Report to the Madras Government of October 1879 estimated the cost of crushing quartz at 9s 6d per ton. This is based on actual experience, steam-power being however allowed for, while if water could be made the motive power (as is being done in Wynaad and no doubt would be the case here) a saving would be effected. One of the Wynaad mines even with inferior machinery has been actually worked at R6 per ton, and gold being reckoned at R2 per dwt. (and twenty dwts. to the oz.), three pennyweights would cover the cost, while one oz. of gold to the ton of quartz—considered a moderate estimate—would yield a profit of R34 per ton. The quantity of work done depends on the number and weight of "stampers" used, and here is how Mr. Brough Smyth works out the operation :—

10 stamper costing £5,000. inclusive of cost of erection and building, will crush 25 tons in the 24 hours; 40 stamper, costing £20,000, will crush 100 tons. Then 100 tons at a gold profit of R34 per ton=R3,400 per day, and in 300 working days=R10,20,000 per annum.

If however the estimate is reduced to $\frac{1}{2}$ oz. per ton, the result would still be a profit equal to 35 per cent on the capital invested. As to yield the average experience gained in Australia for the 16 years ending 1876 was $11\frac{1}{4}$ dwts. per ton, but it is

believed that the quartz in some portions of the Mysore and Wynaad (and why not Ceylon?) districts is richer than that of Australia. Already one Indian Company have extracted 40 ounces f om 44 tons of ore, and that with very indifferent machinery. We have therefore good reason for saying that the time has come for Government to cause a sufficient examination to be made of the gold-yielding region of Ceylon—more particularly in Kadugannawa and Dolosbage. Mr. Brough Smyth will shortly return from Australia to India accompanied by practical miners, and would it not be well for Lieutenant-Governor Douglas to ask the Madras Government beforehand that Mr. Smyth should be allowed to visit and report on the local region referred to before he continues his journey from Galle to Madras? Possibly he might detach one or two miners to carry on the necessary explora ion. It cannot now be pleaded that there is a want of money—that our revenue is likely to be short of the estimate. We may base the claim for expenditure on gold exploration or trial mining and crushing on the Pearl Fishery surplus alone. The official estimate is R400,000 from this source. Surely, Mr. Douglas will not grudge a small portion of the surplus which will shortly be shewn (according to general expectation) to the work we have pointed out. It remains for the merchants and planters interested to say whether a public meeting should be held with the view of urging Government to comply with the request to ask for Mr. Brough Smyth's services to examine and report. Possibly, Mr. Dixon might be able to do all that is needful by way of preliminary geological enquiry ; but Mr. Smyth is so well-known in the Goldmining world from his official position in Victoria,that his report would have the highest possible authority one way or the other, and would, we have little doubt, be well worth all the money spent on it.

GOLD IN SOUTHERN INDIA AND CEYLON :

Experimental Stations for Coffee Culture in Travancore and Ceylon.

We had only passed our remarks of yesterday to the printer when, by a rather noteworthy coincidence, we received a communication from a gentleman now engaged in surveying several of the Travancore plantations for quartz reefs. Some weeks ago in noticing the latest Report of the Aberdeenshire Agricultural Association we alluded to the valuable work done for farmers in the North of Scotland by their Consulting Chemists, Mr. Thomas Jamieson and Mr. J. MacDonald Cameron. We had no idea then that the latter gentleman was in India advising our brethren across the water on the Travancore hills as to the prospect of a gold-yielding reef being found in their properties and also on the best means of improving their cultivation where coffee and other products were likely to pay better than goldmining. Mr. MacDonald .Cameron was commissioned in November last by a syndicate of coffee planters to proce d to Travancore to survey several of the estates for quartz reefs. This mission has been, in some cases, attended with very great success, but to what extent particularly, our informant is not permitted to say. But it has struck Mr. Cameron while working in Travancore that the planters in some of our Ceylon districts where old coffee is in rather a bad way might think it worth their while to ascertain the mineral resources of their estates, and, as he will be in Colombo early next

month on his way home, they would have a good opportunity of conferring with him on the subject. As Mr. Cameron is certain to call at this office immediately he arrives, we shall be glad to receive any communications intended for him. He was Assistant for some time in the Royal School of Mines, South Kensington.

Besides reporting on the quartz reef, Mr. Cameron has taken advantage of his visit to Travancore to impress upon the planters the desirability of their establishing experimental stations to get the full benefit of chemical science in aiding their industry, if they are to continue to hope for the recovery of the capital invested in what, for the past few years at least, has not been a very successful pursuit. This suggestion is now under the consideration of the Committee of the Travancore Planters' Association and will be definitely settled next week. The time has surely come for Ceylon, which has always been foremost in coffee cultivation, to adopt a similar course, and it may be a question at this moment for the consideration of the Committee of our Planters' Association whether three or four experimental stations should not be established and worked in correspondence with those in Travancore under the direction of the same chemist. Such a course would, at least, have the advantage of lessening the cost. For a proof of the resulting benefit, we need only point to the letter of Mr. Graham Anderson of Mysore, who is really carrying on an experimental station for the benefit of his brother planters in India and Ceylon. When Mr. Cameron arrives, we shall have to learn the minimum cost and other particulars of the experimental stations he would recommend, because it is possible that each of our larger districts, or even a divisional group of proprietors, might wish to carry on an experimental piece of cultivation under scientific direction. Mr. Cameron has already done good work both in England and Scotland in developing and promoting scientific agriculture, and in this respect, as well as in connection with the examination of quartz reefs, we trust his visit in Ceylon will not be without results.

At the same time, and whatever advantage may be taken by private individuals or public Associations of Mr. Cameron's services, we do not think that the proposal to secure Mr. Brough Smyth and his practical miners to report on our auriferous region should be lost sight of by His Excellency the Lieut.-Governor. Mr. Smyth's prolonged connection with the Victoria Government and his engagement with the Madras Government afford special reasons why the Ceylon Government, if it moves in the matter at all, as we hope it may, should endeavour to secure his services.

As regards "gold in India," we may quote as follows from a letter received yesterday from a correspondent at Tellicherry :—

"Mr. J. D. Massey (formerly of Kandy) has been busy in the Wynaad reporting and reef-testing for English brokers and Directors of Gold mining Companies. Nothing but 'gold, gold,' talked of over here, and it 's not all mere talk, but actual results. A friend has sold half his coffee estate for an enormous sum—over £60,000 it is said !—but the coffee is of little use, the attraction being a splendid reef running through it."

With reference to gold in Ceylon we notice that in Nov. 1868 a find of gold nuggets in the Sabaragamuwa district excited attention and was referred to in the *Observer* as follows :—

"At the moment there is considerable excitement created at the report of what looks like a real gold discovery in Saffragam, the district which has been ever famous for its gems, Ratnapoora, the name of its chief town, indeed, signifying 'the city of rubies.' The quality of the nuggets brought to Colombo is of the very finest. The only question is one of quantity, and it is quite possible that, in the lower strata of rocks, gold as well as gem-bearing quartz may be found in abundance. Did time permit the probable effects of a profitable gold field in Ceylon might afford matter for interesting speculation.

"Real nuggets have been found by a 'gemming' party in Saffragam. The pieces which have reached the Kachcheri are from $\frac{1}{8}$ to $\frac{3}{8}$ of an inch in

length, of various breadths, flattened and much like specimens from New Zealand. A mass of the weight of half a sovereign, tested as true gold has been melted from the nuggets and is declared to be 22 carats—better than sovereign gold."

We have been asked to republish in pamphlet form all the information given in the *Observer* during 1854 respecting the exploration and prospecting for gold, and we shall at once proceed to comply with the request, adding one or two useful papers on "How to find gold," and cognate subjects. Some of the results of a development of Gold-mining enterprise in India, and to a great extent in Ceylon, may be seen from the following extracts from Mr. Hyde Clarke's paper on "Gold in India":—

"So far as concerns the Indian gold, the districts now under consideration are in a hill region, subject to a very heavy rain-fall. This is carried off by streams, and in some parts will not be available, and cannot be founded or secured by bends. There are, however, estates where streams, and in other districts storage, are available for water. In fact, India in these respects has advantages equal to most portions of the Californian regions, and beyond Australia. There are few parts of New Zealand better provided, nor are there in Brazil.

"Thus, where an estate has a good reef on it, and the water well laid on, the prospects may be looked upon as hopeful. Still, there will be vicissitudes, a season of short rainfall, the bursting of dams, and various incidents, which may interrupt steady working.

"From the real investment of capital in India, notwithstanding much loss, a fair return to this country may be expected. Machinery makes a market for other machinery, and so does the supply of engineering workmen to a country. With a large number of such men attached to the mines, it may become possible to introduce and use other machinery not otherwise available. The expenditure for wages is not likely to be excessive, it will check itself, as when found unremunerative, it will be stopped. Even the large salaries of superintendents and skilled officers cannot be a total loss to us, as many of these men will remain, and open up other enterprise. A very good example of this is given in the *St. James's Gazette* of this evening. In consequence of the increase of machinery in the Linares lead district of Spain, the olive growers have taken to the purchase of improved machinery, instead of the old wooden oil presses. It will be noted that the Belgium manufacturers, having got into the district, obtained the benefit of this new business.

"Although rather a speculative mode of regarding that and other such operations, it is a true one that whatever the direct result, there must be a gain from introducing into India, Englishmen of intelligence and enterprise. Such considerations are entitled to particular weight, when we come to regard the national relations of such undertakings. It may be said, indeed, we are hedged against loss in a material point of view. It is in this respect that England, in the long run, is found, not to have been a loser in the many disastrous ventures in gold mines of fifty years ago. The internal losses were very painful to many over-speculative persons, but in the event, the country was no loser.

"Although here was some loss in Brazilian mines yet others give a return, and in the end we have got hold on the produce of Brazil, which has, in all kinds of ways, been a benefit to us.

"In fact, it is from no single set of figures that the real influence and value of such operations can be determined, and they must be examined as a whole, and in their full results, with all their losses and all their gains. These the balance-sheet of a mining company will not disclose, as it will not shew the effective distribution of capital. There may be loss to the shareholders, and gain to the manufacturer and the merchant.

"A very important consideration is the supply of labour. The want or failure of this has put a stop to mineral industry in many countries. Thus, in Brazil, in the Portuguese time, the numerous and productive mines of the auriferous districts depended on slave labour. With the emancipation of the

negroes, whole districts were thrown out of yield, and it is only by close attention that labour has been obtained for the St. John del Rey mines, and the large dividends have been kept up. The supply of labour must be free and continuous, and consist of men who are disposed to engage in such a pursuit. This is the strength of Chilé, where the natives are content to undergo the drudgery, and receive regular wages, or as tributers, run their chance of the prizes of rich and casual finds.

It is likewise necessary to have English or other foreign miners who understand the business, are willing to go abroad, and encounter with or without their families, the vicissitudes of distant travel. So far as this population is concerned, we have it at home in Cornwall and Wales, whence many proceed, not only to English countries in Australia, South Africa, Canada, and the United States, but to foreign lands. They are as familiar with the hot climates of Brazil, Chilé, and Mexico, as with any of the regions they frequent. Then there are our Australians. There would, consequently, be no difficulty in obtaining a supply of workmen for our Indian Empire, where they are under English protection. The same circumstance will favour in case of need, the introduction of foreign miners. The mass of the labour, however, will be local.

Our own people are well acquainted with gold mining in Australia, New Zealand, California, Brazil, and Columbia, and it is not a business that they have to learn—but one on which they have been largely engaged.

Apart from any operation on the coinage of India and on the exchanges, it is to be expected that a much more important influence will be effected on local prices of wages and commodities. Looking at these from an English point of view, it has been too much the custom to consider them as dependent on English conditions. There is, however, very little contact between what may be called the English system of prices, and the Indian system of prices.

The contact is effected by the export from India to England of sugar, coffee, rice, cotton, jute, &c., the prices of which for export are determined by the London or European market prices. This, however, exercises very little influence on the main bulk of the agricultural crops of India.

Far different are the relations between England and the countries on the adjoining seas, Ireland to the west, and the shores to the east and south. Every pound of meat, every fowl, every egg, each pound of butter, and all fresh vegetables or fresh fruits are liable to be taken up for the great markets of London and Paris, the prices of which, with the cost of transport, govern those of the outlying districts. Hence the general complaints of the growing dearness of living in the large and small towns, and which lends not to a levelling of prices in the proper sense, but to an augmentation of price to the higher standard.

Within each region, the completeness of railway transit contributes to such results, and the seas are bridged by steam transport, also penetrating the rivers, the prices of food affect the prices of labour to a considerable extent, and modify the operation of other causes. The Irish labourer, who, half a century ago, received 4d to 6d per day, or Indian wages, now received 2s or more.

In India, as has been pointed out by me, in common with others, similar results have, of late years, been seen in operation, but they have not reached their full development, and must, therefore, continue until it has been attained. This is the point to which the attention of economists must be turned, because the quicker or slower rate of this development means the earlier or later attainments of an advanced condition by the population of Indies, and the consequent rate of public revenue.

So long as the great disparity of rate of prices between India and England exists, there must be a disturbance of all economical relations. There must be a really abnormal relation of imports and exports, an abnormal disproportion between the amount remitted to England and the rest of the revenue of India, a false relation between the supply of capital to India and its returns.

Taking this last head alone, India labours under great disadvantages as compared with many other countries. If a railway be made, say in the United States with English capital, then the returns can be calculated upon at something like English prices. In India this is not so; the railway iron are machinery shipped from England is of the same indentical cost, but the carrlage of commodities and of passengers has to be undertaken on a scale wholly different. No question arises elsewhere, for instance as to the carriage of passengers at 2 pice per mile. In some countries it is impossible to charge an anna or two, as here at Home.

That, in many classes of enterprise, where the amount of traffic, or transport, or commodities dealt with in India would, at what may be called normal rates produce a good return, in India they give an insufficient money yield, the undertaking becomes impossible with profit, or without a guarantee burdensome to the Government, and the abundant capital of the European markets is not applied to India, while it is freely available for alien countries, which have no claim on English sympathies, in Brazil or in Chilé.

It is the rise of prices now going on in India, and already referred to, which will act independently and concurrently affect the situation, dominate the commercial and financial conditions. It is, therefore, perfcetly futile to talk of the application of great economical lands, when we neglect the circumstances on which their operation depends.

The development of gold working means the development of English knowledge and enterprise, and the consequent progress of India. Then the railway system will no longer be stinted, and the correspondent benefits will be obtained. Many a commodity will rate locally at a higher price in consequence of higher wages, but the efficiency of railway transport, as compared with the bullock carts, will place the commodity at the port, under commercial conditions. Many commodities, which now cannot be moved and are expended from trade, will under quick transport, become exchangeable articles of commerce. If these results were only to be regarded as possible or probable, the whole subject of the gold fields would be worthy of the gravest consideration, and as one not to be dismissed on doubts, or on the absence as yet of ascertained realisation.

GOLD IN CEYLON.

Our attention has been called to the references made by Sir Samuel Baker in his "Eight Years in Ceylon" to the "Prospecting for Gold" in this Colony which occupied public attention in 1854. He puts the matter very plainly before his readers, and certainly does not spare Sir George Anderson's government:—

In Ceylon, where the chief article of production is coffee, land (upon an estate) which is not suitable to this cultivation is usually considered waste. Thus the Government and the private proprietor are alike losers, in possessing an amount of unprofitable soil.

Now surely it is the common sense object in the establishment of a botanical garden, to discover for each description of soil a remunerating crop, so that an estate should be cultivated to its uttermost, and the word 'waste' be unknown upon the property.

Under the present system of management this is impossible; the sum allowed per annum is but just sufficient to keep the gardens in proper condition, and the abilities of the botanist in charge are sacrificed. Many a valuable plant now lies screened in the shades of remote jungles, which the enterprising botanist would bring to light, were he enabled by Government to make periodical journeys through the interior. These journeys should form a part of his duties; his botanical specimens should be his game, and they should be pursued with the ardour of the chase itself, and subsequently transferred to the gardens, and their real merits discovered by experiments.

But what can be expected from an apathetic system of Government? Dyes, fibres, gums may abound in the forests, metals and even gold may be concealed beneath our feet; but the Governor does not consider it apart of his duty to prosecute the search, or even to render facilities to those of a more in dustrious temperament. What can better exemplify the case than the recent discovery of gold at Nuwara Eliya?

Here was the plain fact, that gold was found in small specks, not in one spot, but *everywhere* through out the swamps for miles in the vicinity. At a depth of two or three feet from the surface, this proof was adduced of its presence; but the Governor positively refused to assist the discoverers, ('diggers,' who were poor sailors visiting Ceylon), although they merely asked for subsistence until they should be able to reach a greater depth. This may appear too absurd to be correct, but it is nevertheless true.

At the time that I commenced these sketches of Ceylon, the gold was just discovered, and I touched but lightly upon it, in the expectation that a few months of labour, aided by Government support, would have established its presence in rem unerating quantities. The swampy nature of the soil rendered the digging impossible, without the aid of powerful pumps to reduce the water; which filled the shaft so rapidly, that no greater depth could be obtained than 18 feet.

The diggers were absolutely penniless, and but for, assistance received from private parties they must have starved. The rainy season was at its height and torrents fell night and day with little intermission. Still these poor fellows worked early and late, we and dry, ever sanguine of success, and they at length petitioned the Government to give them the means of subsistence for a few months—'subsistence' for two men, and the assistance of a few coolies. This was refused, and the reply stated that the Government intended to leave the search for gold 'to private enterprise.' No reward was offered for its discovery as in other colonies, but the Governor would leave it to 'private enterprise.' A promising enterprise truly, when every landholder in Ceylon, on referring to his title-deeds, observes the *reservation of all precious metals to the crown.* This is a fair sample of the narrow-minded, selfish policy of a Government which, in endeavouring to save a little, loses all; a miserable tampering with the public, in attempting to make a cat's paw of private enterprise.

How has this ended? The diggers left the island in disgust. If the gold is there in quantity, there it remains to the present time, unsought for. The subject of gold is so generally interesting, and in this case of such importance to the colony, that, believing as I do that it does exist in large quantities, I must claim the reader's patience in going into this subject rather fully.

Let us take the matter as it stands.

I mentioned at an early part of these pages, that gold was first discovered in Ceylon by the diggers in the bed of a stream near Kandy; that they subsequently came to Nuwara Eliya, and there discovered gold likewise.

It must be remembered that the main features of the country at Nuwara Eliya and the vicinity are broad flats or swampy plains, surrounded by hills and mountains: the former covered with rank grass and intersected by small streams, the latter covered with dense forest. The soil abounds with rocks of gneiss and quartz; some of the latter rose-colour, some pure white. The gold has hitherto been found in the plains only. These plains extend over some thirty miles of country, divided into numerous patches by intervening jungles.

The surface soil is of a peaty nature, perfectly black, soapy when wet, and as light as soot when dry; worthless of cultivation. This top soil is about eighteen inches thick, and appears to have been the remains of vegetable matter washed down from the surrounding hills and forests. This swampy black soil rests upon a thin stratum of brownish clay, not more than a few inches thick, which forming a second layer, rests in its turn upon a snow-white rounded quartz gravel intermixed with white pipeclay. This contains gold, every shovelful of earth producing, when washed, one

or more specks of the precious metal. The stratum of rounded quartz is about two feet thick, and is succeeded by pipeclay, intermixed with quartz gravel, to a depth of eighteen feet. Here another stratum of quartz gravel is met with perfectly water-worn, and rounded to the size of a twelve-pound shot. In this stratum the gold was of increased size, and some pieces were discoverd as large as small grains of rice; but no greater depth was attained, viz., eighteen feet from the surface. No other holes were sunk below ten feet, on account of the influx of water, but similar shafts were made in various places, and all with equal success. From the commencement of the first stratum of quartz throughout to the greatest depth attained gold was present.

Upon washing away the clay and gravel, a great number of gems of small value remained (chiefly sapphire, ruby, jacinth, and green tourmaline). These being picked out, there remained a jet black fine sand, resembling gunpowder. This was of great specific gravity, and when carefully washed, discovered gold, some in grains, some in mere specks, and some like fine golden flour.

At this interesting stage the search has been given up; although the cheering sight of gold can be obtained in nearly every pan of earth, at such trifling depths, and literally in every direction, the prospect is abandoned. The Government leave it to private enterprise; but the enterprising public have no faith in the Government.

Without being over sanguine, or, on the other side closing our ears with asinine stubbornness, let us take an impartial view of the facts determined, and draw rational conclusions.

It also appears that from a depth of two and a half feet from the surface to the greatest depth as yet attained, (eighteen feet), gold exists throughout.

It appears that this is not only the case in one particular spot, but all over this part of the country and that this fact is undeniable; and, nevertheless, the Government did not believe in the *existence* of gold in Ceylon until these diggers discovered it; and when discovered, they gave the diggers neither reward nor encouragement, but they actually met the discovery by a *prohibition* against the search; they then latterly withdrew the prohibition and left it to private enterprise, but neglected the unfortunate diggers. In this manner is the colony mismanaged, in this manner is all public spirit damped, all private enterprise checked, and all men who have anything to venture disgusted.

The liberality of a Government must be boundless where the actual subsistence for a few months is refused to the discoverers of gold in a country where, hitherto, its presence had been denied.

It would be speculative to anticipates the vast change that an extended discovery would effect in such a colony as Ceylon. We have before us the two pictures of California and Australia, which have been changed as though by the magician's wand within the last few years. It becomes us now simply to consider the probability of the gold being in such quantities in Ceylon as to effect such changes. We have at present these simple data,—that in a soft swampy soil gold has been found close to the surface in small specks, gradually increasing in size and quantity as a greater depth has been attained.

From the fact that gold will naturally lie deep, from its specific gravity, it is astonishing that any vestige of such a metal should be discovered in such spongy soil so close to the surface. Still more astonishing that it should be so generally disseminated throughout the locality. This would naturally be accepted as a proof that the earth is rich in gold. But the question will then arise—Where is the gold? The quantities found are a mere nothing, it is only dust: we want 'nuggets.'

The latter is positively the expression that I myself frequently heard in Ceylon,—'We want nuggets.'

Who does not want nuggets? But people speak of 'nuggets' as they would of pebbles, forgetting that the very principle which keeps the light dust at the surface, has forced the heavier gold to a greater depth, and that, far

from complaining of the lack of nuggets when digging has hardly commenced, they should gaze with wonder at the bare existence of the gold in its present form and situation.

The diggings at Ballarat are from 100 to 160 feet deep in hard ground, and yet people in Ceylon expect to find heavy gold in mere mud, close to the surface. The idea is preposterous, and I conceive it only reasonable to infer from the present appearances, that gold does exist in large quantities in Ceylon. But as it is reasonable to suppose such to be the case, so it is unreasonable to suppose that private individuals will invest capital in so uncertain a speculation as mining, without facilities from the Government, and in the very face of the clause in their own title-deeds 'that all precious metals belong to the crown.'

This is the anomalous position of the gold in Ceylon under the governorship of Sir G. Anderson.

Nevertheless it becomes a question whether we should blame the man or the system; but the question arises in this case, as with everything else in which Government is concerned, 'Where is the fault?' 'echo answers, "Where?" But the public are not satisfied with echoes, and in this matter of fact age people look to those who fill ostensible posts and draw *bona fide* salaries; and if these men hold the appointments, no matter under what system, they become the deserved objects of either praise or censure.

Thus it may appear too much to say that Sir G. Anderson is liable for the mismanagement of the colony *in toto*—for the total neglect of the public roads. It may appear too much to say, when you came to the colony you found the roads in good order: they are now impassable; communication is actually cut off from places of importance. This is your fault, these are the fruits of your imbecility; your answer to our petitions for repairs was, 'There is no money;' and yet at the close of the year you proclaimed and boasted of a saving of 27,000*l.* in the treasury! This seems a fearful contradiction; and the whole public received it as such. The governor may complain that the public expect too much; the public may complain that the governor does too little.

Upon these satisfactory terms, governors and their dependants bow each other out, the colony being a kind of opera stall, a reserved seat for the governor during the performance of five acts (as we will term his five years of office); and the fifth act, as usual in tragedies, exposes the whole plot of the preceding four, and winds up with the customary disasters.

Now the question is, how long this age of misrule will last.

We trust the present Government of Ceylon will lay this lesson to heart and act in a rather more energetic and liberal manner than did its predecessor twenty-seven years ago. Meantime, it is of some practical importance to the Colony to have so staunch a believer in its auriferous wealth as Sir Samuel Baker at headquarters. He is the special friend of His Grace the Duke of Sutherland (who, by the way, visited Kandy and Nuwara Eliya in 1875), and of other enterprising public men in England who would speedily ensure the development of gold mines here, provided it were shewn on competent authority that a paying reef were available. From the article on "Gold" in the latest issue of the "Encyclopædia Britannica" we quote some passages of general interest at this moment:—

The association and distribution of gold may be considered under two different heads, namely, as it occurs in mineral veins and in alluvial or other superficial deposits which are derived from the waste of the former. As regards the first, it is chiefly found in quartz veins or reefs traversing slaty or crystalline rocks usually talcose or chloritic schists either alone or in association with iron, copper, magnetic and arsenical pyrites, galena, specular iron ore, and silver ores, and more rarely with sulphide of molybdenum, tungstate of

calcium, bismuth, and tellurium minerals. Another more exceptional association, that with bismuth in calcite from Queensland, was described by the late Mr. Daintre. In Hungary, the Urals, and northern Peru, silicates and carbonates of manganese are not uncommonly found in the gold and silver bearing veins. In the second or alluvial class of deposits the associated minerals are chiefly those of great density and hardness, such as platinum, osmiridum, and other metals of the platinum group, tinstone, chromic, magnetic, and brown iron ores, diamond, ruby, and sapphire, zircon, topaz, garnet, &c., which represent the more durable original contituents of the rocks whose disintegration has furnished the detritus. Native lead and zinc have also been reported among such minerals, but their authenticity is somewhat doubtful. * * * *

In vein mining, which is more difficult and costly, a larger yield is necessary, but probably 5 dwts., or about £1 in value per ton, will in most places represent paying quantities from quartz containing free gold, i.e., not associated with pyrites. The proportional yield and quantities of the different kinds of auriferous materials treated in the colony of Victoria during last the three months of 1878 were—

	Tons.	Yield per ton. oz.	dwt.	gr.
Alluvial sand "washdirt"	173·379	1	1	59·6
Cement (gravel) requiring crushing	5871		4	21·4
Quartz	222·775		9	21
Quartz tailings	11·139		1	18
Pyrites and blanketing (or collected on blanket tables)...	1·599	2	6	13·7

In the less tractable minerals, such as arsenical pyrites occurring in the lower portions of the veins, as much as one-and-half to three ounces may be required for profitable working. When associated with the ores of other metals, such as silver, lead and copper, the extraction of the gold is in most cases an incidenta and final operation in their metallurgical treatment and may therefore be best considered in the articles on these metals.

GOLD IN CEYLON.

We now proceed to reprint all that appeared on the subject of "Gold in Ceylon" and connected topics, in the *Observer* of 1854:—

(From the *Colombo Observer* Mareh 2, 1854.)

To crown all, there are rumours afloat that some experienced Australian diggers have been prospecting not far from Colombo and have discovered a regular "Table" of Gold. We receive this rumour with great caution. Gold distributed in dust or flakes exists in Ceylon as it does wherever there is quartz; but, well peopled as this country has been for ages, and thoroughly searched for precious stones, we scarcely think that nuggets or masses of gold could have escaped discovery. Nothing is impossible however, and deep digging may reveal what surface explorers, practical and scientfic have sought for in vain.

(From the *Colombo Observer*, March 9, 1854.)

We are bound to state that all the information we have received since our last tends towards the probability of a discovery of gold, although it will be well to reserve implicit credence to the statements made until the report of the Superintendent of Police, who is proceeding to the spot has been obtained. It appears that some of the men engaged in navigating the ship "Faithful," had been diggers in Australia. On their arrival here, six of them asked Capt. Manning for a few days' leave to go "prospecting," under the firm conviction, looking at the features of the country, that Gold existed. The leave was granted, and it would appear that the men journeyed along the Kandy road to the 32nd mile-stone, then striking away to the left. It would seem that this brought them to the bed of the Maha Oya on the borders of the Hapitigam Korale, just within the boundary of the

Western Province, where it joins the district of Kurunegala. Here they commenced at once to wash the quartzy sand by the aid of a simple wicker appliance known amongst the diggers as a "Tom." The immediate result, according to two of the men who returned to Colombo to report was, that Gold dust was found in quantity not only to repay the labour of washing, but to justify the assertion that the discovery would make Ceylon a rich country, The Gold dust was brought to Colombo, and the result of various tests to which it was subjected at the Medical Store is a decision that it is pure gold. The remaining question then of course was, "Did this gold come originally from Australia and were the sailors hoaxing." The only means as yet available to set this question at rest has been a close examination of the two men who returned and we are informed that the result of such an examination has been very much in their favour. They gave the fullest and most candid account of all their proceedings and, appeared quite pleased at the idea of the Superintendent of Police accompanying them to where they had left their four companions at work. In a few days, therefore, Mr. MacCartney's report to Government will set this important question at rest, deciding that Ceylon is to "hasten slowly" in her career of coffee and coconut planting, or setting our friends, the planters, quaking in their shoes at the prospect of the great though temporary dislocation of all existing relations of labour, capital and enterprise which must ensue as the precursors of the period when Ceylon shall rapidly rise to the dignity of a nation teeming with a wealthy people and traversed in every direction by Roads and Railways and Electric Telegraphs. Great revolutions are occurring in the earth, and why should not the ancient Taprobane awake from the slumber of ages, proving that if she is not the Ophir of Solomon, she is yet the land of Gold! We believe the earth is yet young:

We are the ancients of the earth
And in the morning of the times.

(From the *Colombo Observer*, March 11, 1854.)

But probably the most striking item of intelligence from Ceylen on this occasion is that which announces the alleged discovery of Gold by some Sailor Diggers from Australia. It is greatly to be regretted that the present Mail should leave Ceylon with the question in an uncertain state. The Superintendent of Police proceeded to the scene of the alleged discovery, about 30 miles from Colombo, on the evening of the 9th, and his report is anxiously expected. Our readers will not err, we think, in exercising a considerable degree of scepticism as to gold being found here in sufficient quantities to render working for it so remunerative as to interfere with other and established industrial pursuits. We wait for information, however, and say boldly "Who's afraid." In our columns will be found the best accounts we could get hold of, but as usual in such cases there are errors of detail. Capt. Manning of the "Faithful" corrects some which affect him, in the following letter:—

Barque "Faithful," Colombo Roads, March 11th, 1854.

SIRS,—Having seen a paragraph in your *Journal* of the 9th instant, entitled "Gold in Ceylon," I beg to contradict that part of it which relates to my Ship and Self. The paragraph I allude to, runs thus:—"It appears that some of the men engaged in Navigating the Ship "Faithful" had been "Diggers" in Australia, on their arrival in this Port six of them asked Capt. Manning for a few days leave to go "Prospecting" under the firm conviction looking at the features of the country that Gold existed. The leave was granted, &c., &c."

Now sir, on my arrival at this port I took all these "Runner" before the Collector of H. M. Customs and formally discharged them. Some few days after seven of them returned to the Ship and wished to sail in her again; after being on board two days and not on the Ship's Articles, some intelligence appears to have reached them from the shore, for on the third day four of them made various excuses that they wished to leave the ship, one said I want to get back to "Australia," a second I want to see a doctor,

the other two said 'two of us is not enough to tar the rigging down and we will thank you to let us leave the ship."

I, having no claim on the men, had no alternative but to let them go. No mention whatever was made of Gold to me and it was several days after that I heard a rumour about the Gold. All I hope is they may *not* find the old proverb come true that "It is not all gold that glitters."

I remain yours truly,

JOHN MANNING.

Master Bk. "Faithful."

(From the *Colombo Observer*, March 12, 1854.)

In our last ordinary issue we announced the all-but certainty of Gold in Ceylon; and have now the pleasure to state that doubt is entirely removed by the arrival of the joint report (then expected) of Mr. MacCartney the Superintendent of Police, and Mr. T. Power Assistant Government Agent, which says that they witnessed the digging and washing of "*two pans of Earth*" which contained "*very many minute particles of Gold.*"

Their report is dated "Yattegodde, 11th March (yesterday) and is unavoidably hurried in order to reach Colombo in time to be forwarded by Government to the Secretary of State by the out-going Overland Mail.

We may add that the Mudaliyar (Native Headman) of the District sent in yesterday to the Government Agent of Colombo a specimen of the Gold which he also saw dug by the Sailors; and that Mr. Layard will leave for the spot this evening.

The locality is about 40 miles from Colombo—near Girooele on the road from Negombo to Kurunegala. A good carriage road runs all the way from Colombo to the scene of action.

We have as yet no precise information about the proportionate quantity of Gold which the earth contains; but it cannot be insignificant, seeing that the Sailors have made the discovery, and are old Californian and Australian Diggers, continue at the work.

The next report we hope will be the result of *personal* inspection.

THE DISCOVERY OF GOLD IN CEYLON.

The above was got up yesterday with special reference to the Express which left at ½ past 5 to overtake the Overland Mail. Copies were despatched to all the leading London Newspapers, to Subscribers to the Overland Observer, whose papers are posted from our Office, and to our Subscribers generally. The question as to the substance found being Gold seems entirely set at rest, all the Government Officers concerned expressing no doubt of this fact, and all the chemical tests applied to the specimens received giving the same result and determining the Metal to be Gold. The remaining question —and one which we hope soon to see settled by the Report of our special Commissioner who left for the Diggings last night—is the percentage of auriferous matter in the quartzy sand. No nuggets, we believe, have as yet been found, altho' they may be discovered farther *down* in the earth, or farther *up* towards the source of the Maha Oya in the Mountains of the Interior. If Gold *dust* only continues to be found, the question of the pursuit becoming highly remunerative will remain still doubtful. Many of our friends, we suspect, will fervently pray that this latter may be the eventual result. A contrary one would doubtless lead to much temporary embarrassment and distress, but it would be ultimately ("the making") of Ceylon and its people. Nothing like gold for "developing the dormant resources" of a country and the dormant energies of individuals. While we are writing, a respectable Burgher steps into our office, and begs us to suggest to the unemployed young men of his class, that while Europeans are posting away to see for themselves, *they*, so much more closely bound to the soil, ought not to be behind. Bands of them can club together and support each other in dignifying the mamotie and the cradle to an elevation as great as that occupied by the pen of the copyist. Should Gold digging really become a permanent and

profitable pursuit, we have little doubt that after a time it will assume what appears to be the normal condition of enterprise in India—Asiatic labour supported by European capital and guided by European oversight. The Tamil coolies from Southern India will pour in, in multitudes. But in this and in other things they will act much like children. They will look to Europeans for regular arrangements to procure shelter and supplies, they in return working for day wages or a definite share in the proceeds. And then as in Australia, many will become disgusted at want of success—they will prefer the steady and certain receipt of the Planters' rupees, and by and by there will be a superabundance of labour to cultivate and gather coffee. No fear that intelligent, enterprising and foreseeing Anglo-Saxons with some capital at their command will allow themselves or their investments to go to the wall. But other classes besides intelligent Europeans and docile Natives will come upon the scene. Face to face with the timid Asiatic will be brought the rough sons of labour of Europe and America—not the steady and the good but the reckless pioneers in all that is adventurous and wild drunken, swearing, fighting sailors who will desert the shipping, and diggers from California and Australia with Bowie knifes, and life preservers (?), and Colt's revolvers. How these discordant elements can work together without coming into disastrous or fatal collision will form a problem requiring the most prompt and sagacious action on the part of Government.

Girooella or Girioulle is a village on the left Bank of the Maha Oya on the road from Colombo to Kurunegala via Negombo. We lately travelled over this road as far as Dalpatugedera (within 7 miles of Girooella) and can answer for its being in beautiful order so far. Girooella is about half way between Negombo and Kornegalle, being 22 miles from the former and 25 from the latter. The Hapitigam Korle of the Western Province which borders on the Maha Oya at the place contains a population of 12 to 14,000 inhabitants. In proceeding from Colombo to Girooella the traveller crosses the Kalaniya Ganga over a Bridge of Boats at the 3rd mile stone, and a little beyond the 9th mile finds the Resthouse of Jayelle. Negombo is 10 miles further on, but the road to be pursued turns away to the right just before reaching the town. To Kandawelle at the end of the Base Line thro' Kaderane Gardens is 3½ miles from Negombo. Katoo-kandy, with a number of of Sugar and Cocanut Estates and where Mr. Nietner is trying Nutmegs and Cloves, is 8½ miles further on. Dalpatgedera Village, where the last of the European properties, that of Lt. Margesson, is situated, is 3 miles further on. Then at a distance of 2 miles more is Welliheina or Cottadeniawa, and 5½ beyond the Road terminates at the Ferry and Village of Girooella where the traveller crosses the Maha Oya, a river, the Natives *now* say, so impregnated with gold, that the very waters taste of it! And this raises some interesting Antiquarian questions. It appears from some of the ancient Singhalese Records that many of the villages were distinguished as "gold yielding," and that at one time, at least 16 Gold Mines were known in Ceylon. Query whether Geographers may not have to reconsider the decision which has lately and after much controversy fixed on a portion of the African Coast as the Ophir or Paravaim of the Scriptures, whence Solomon received his gold and apes and peacocks? Ceylon with its great Emporium at Manaar may again become the favourite. The Phenicians are said to have traded in this gold of Ophir long before the time of Solomon and even of Job by whom it is mentioned. And many an old history speaks of expeditions to and

> Embassies from regions far remot,
> From India and the Golden Chersonese,
> And utmost Indian isle Taprobane.

We observe that the local *Times* in a small Extra issued this morning continues to express himself sceptical as to the substance received being actually gold, but on this head there remains no doubt. Our contemporary states that a quantity is under analysis by Dr. Ellery of Kandy. Dr. Ellery's Report has reached Colombo, and we learn that it entirely agrees with that of Mr. Anthoniz

here. It is gold ore in connection with a supplement of iron and small nodules of other substances. It is curious enough that Dr. Davy in his work in Ceylon should have recorded the statements that both Gold and Quicksilver had been found Native in Ceylon only to throw doubt on them. Able and keen as Dr. Davy was as an observer, however, it must be remembered that the period of his residence, and the extent of his researches were limited.—We have received the following notes on the subject of the discovery :—

Colombo, 13th March, 1854.

Dear Sirs,—Our planting friends are, I believe, much alarmed lest the discovery of Gold should cause a scarcity of labour for estate purposes, but I fancy their fears are for the present groundless, if it be true that Government, at the instance of the Great Obstructive, has sent a detachment of Rifles to prevent anything being done till the position of each digger's hole can be ascertained with trigonometrical exactness ; in this case we look for the commencement of the diggings in the reign of Albert the Third, and our friends in the interior may keep their minds at ease and depend on gathering their next crop without loss, even should it amount to 600,000 cwts.—
Yours truly, X. Y. Z.

Kandy, 12th March.

I do not know if you have got any official intimation about the *Gold*, but I have just heard that the Governor received intelligence last evening from Mr. T. C. Power who had sent to enquire into the matter, that there was no mistake about it, and gold there was ; and it now only remained to be ascertained as to the extent of the gold fields.

The Natives here have got hold of the report and I expect a few days will see Kandy thinned. A pretty "mess" for a time we shall all be in.

Latest Gold News.

We have just seen the joint Report of Messrs. MacCartney and Power dated yesterday from Yattelgodde.

To satisfy themselves they selected a fresh spot, dug the earth, washed it, and found gold.

The diggers then continued their operations, and out of 3 pans of earth washed a quantity of Gold which Mr. Power was to carry to Kandy for the Governor's inspection.

The small quantity of Gold hitherto found is fairly attributed by the diggers to the imperfection of their machinery. This was to be immediately remedied when the value of the discovery would be decided.

We learn from another source that so confident is the leading digger of success, that when he gets the requisite machinery, he says he can afford to pay parties employed by him £2 per day wages ! He says he is confident there is a much richer spot close to Ambepussa, which he passed on his way to the present locality.

Mr. Caldwell who accompanied Mr. MacCartney from Colombo has drawn a map of the surrounding country from which it appears that the spot where the diggers are at work is just within the Seven Korles District, it being about 50 yards from the Maha Oya where it bounds the Western Province. The locality it appears is within a few miles of Ambepussc.

Hundreds of persons were flocking to the spot, so that it was deemed necessary to leave a small party of Police to preserve order.

In the ancient Manuscript to which we have alluded elsewhere. Gold is specially mentioned as found in *Belligalle Korale*.

(From the *Colombo Observer*, March 16, 1854.)

The "Examiner's" Gold Intelligence.

The *Examiner* issued an Extra last evening purporting to give the result of the personal researches of one of the Editors, but all the real information afforded bears a marvellous resemblance to the two grains of wheat in a

bushel of chaff, or the needle in the bottle of hay. Considering also that the writer is no longer a disinterested party, having invested in the purchase of land for building purposes, his statements, where they lean to the sanguine, must be received *cum grano*. It is certainly very important to know that the diggings are called "Bradley's diggings." That is a fact. But we announced in our regular issue that the locality was close to Ambepusse, and actually within the limits of the Kornegalle district. Why Mr. Layard should be blamed for sending his Modliar to ascertain what personal observation alone could settle, perhaps the writer can explain. The horror indicated at the sin of Sunday travelling is amusing enough, considering the quarter whence it comes. We suppose no portion of that day was occupied by our friend in prospecting or in concluding his bargain with the natives for their lands. Why the diggers should have been angry at the charge of having asked and obtained leave to go prospecting, we cannot well see, but we can easily imagine the more intelligent and reasoning Editor of the *Examiner* mollifying the diggers and telling them candidly that there was nothing to be angry at. That would be the part of a generous man and a gentleman under the circumstances, and of course "Brutus is an honourable man." The public will be glad, however, to learn, that the six diggers had regular discharges from their Captains: three from Capt. Manning of the "Faithful," and three from Capt. Ross of the "Martin Luther." We are thankful to learn that a "Tom" is not "*a wicker appliance*," as in our ignorance we described it, but a sort of wooden box with a perforated iron bottom at the lower end. Besides this "Tom," tin pans are used to bale and fill with. We are told further that "the diggers are making a dam across the river and a hose 80 yards long, and when they have thus obtained a consonant and regular supply of water, which we [Ed. *Ex.*] expect will be by Thursday next—about 12 times the quantity of earth can be worked. Among the soil were found several small rubies, and we took out a piece of Ceylonite.

"We may mention that a native headman a short time ago found some nuggets, one of which he sold to Mr. Jayetilleke Modliar of Kornegalle (who told us the story), which was so soft as to require 9 worth of silver to be added to enable the jeweller to work it. He has been sent for. The place where he found it is stated to be about 5 or 6 miles from that of the present operations.

"P.S.—The best and shortest road is from Colombo to Ambepusse resthouse, 36 miles of admirable road; from thence to "Bradley's diggings" there is a good bridle path 3¼ miles; at Ambepusse resthouse, every needful supply can be obtained."

The above is the sum of the personal observations of our *Examiner* friend. We must be thankful for what we can get; but really we should have wished something more definite as to the nature of the formation in which the gold is found, the percentage yielded by a certain quantity of earth, the time occupied in digging and washing, &c.

All this we hope to have in good time.

The Gold Intelligence of the "Times."

Our friend of the *Times* has articles on the Gold Diggings embodying information supplied, evidently, by the Superintendent of Police and the gentleman who accompanied him from Colombo. These accounts agree with all that we have reported—Gold there undoubtedly is and close to the surface, but whether in sufficient quantities to render digging remunerative remains to be proved. That is the practical and common sense view of the case, but the *Times* Editor finishes off in his own peculiar style and in a manner anything but flattering to his informants. His "P. S." is,

"We have since heard that the diggings are likely to be a failure—or, in other words, all bosh!"

It is quite possible that a failure, economically viewed, may be the result, but until prospecting up towards the mountain sources, and deep diggings and thorough washings have been tried, no one can confidently so decide. It

is the part of wisdom, doubtless, not to be over-sanguine or over-fearful (as the case may be) of a large and valuable discovery of gold; but it is surely also prudent to reserve final opinions until they can be founded on repeated experiments and full information. Our own course will be to collect for our readers all possible information wherever we can find it. The result of personal observation is embodied elsewhere—we have afforded the infinitesimal intelligence contained in the *Examiner* Extra, and we now proceed to glean what we find of interest in the *Times*. We quote from our contemporary as follows :—

"The following are we believe the results of the observations of parties who have proceeded to the spot.

"You go as far as Ambepusse at the 37th mile stone on the Kandy road, and then strike of to the spot round the back of a high well known hill close to the rest house, and follow a bridle path through a jungle for about 3½ miles which brings you to the bank of the Maha Oya at a place called Girioella or Girrawella, at which place Bradley (the gold discoverer) and his two friends are living in a bough hut constructed of the jungle bushes of the place, where they were found busily engaged in making a "Tom," a machine about the length of a common couch constructed of planks with several compartments of spaces one next to the other but each space a little lower than the other, similar to a stair-case. At the bottom is a flat iron plate pierced full of holes which allows the smaller portions of the washings to fall into a reservoir together with the gold :—we may remark that all the "stuff" is first pounded and beaten as much as possible to small fragments to separate any portion of gold which may be amongst its interstices. The residue is a fine black sand, in which the gold is seen in small spangles. This sand on being dried is gently blown away and the gold left, the value of the sand being according to Bradley worth four shillings an ounce in the state it is in before the useless particles are blown off. The new diggers were also preparing a dam across the river to raise the water to a level with the top of their "Tom" which was to be supported two or three feet above the ground. They were also constructing a hose of tarred convass of about 100 feet long, to bring the water to the "Tom," the object being to obtain a continuous and gentle stream of water pouring on the mass of "stuff" supplied to the "Tom." We hear that Bradley was complaining bitterly of the extortions of the natives already, his coolies asking a rupee a day—fowls were at 1s. 6d.—whilst for a few bits of plank to make his "Tom" he had to pay 15 shillings—the beginning of the end, if gold is actually to be found in Ceylon.

"We are told that in the vicinity of the place were Bradley and his friends are, the natives exhibit the utmost apathy, looking on without the slightest interest in their proceedings beyond what they can make out of them. They are now well supplied with provisions including wines, hams, flour, beef, *etcetera*, and appear determined to enjoy the real life of a digger. Bradley says he has lost three fortunes already, and is so perfectly persuaded of the richness of the locality that he can afford to pay £2 a day for a cooly to dig for him, and with the profits set up a "Public" and make a rapid fortune. Allowing for a few little eccentricities inherent to a sailor, they all appear intelligent men, and appear to be fully aware of what they are about. We however suspect the first thunderstorm in the hills will rather astonish them when they see the short work a fresh in the Maha Oya will make of the dam they have constructed.

"As Bradley and his companions are for the nonce public characters, we must tell one or two anecdotes which are quite refreshing

"One of the Modliars gave the party a dinner over the river, and on their return the next day, the other Modliar asked Bradley what time got home :—'Got home! said he, why really I don't know—for I left my watch on the piano.'

"On their way over on a raft the whole of them got upset in the stream, but "happy go lucky" they would insist on dining in their wet

clothes. On their return they took to the water again, but being unable to find the opposite shore, they returned to the bank and lay down to sleep, wet as they were in the sand. It is easy to see if they indulge in such pranks as those that a month must end their career in such a climate as the one they are located in, where independently of the notorious unhealthiness of the place, the heat is described as being almost unbearable. We understand that a day or two ago some six or seven other seamen of ships in the roadstead left Colombo for the new diggings, and some three or four have followed to-day."

One idea which occurs to us on reading the above is that with an excellent road to Ambepusse and a coach daily passing down, it may ultimately be found preferable to perform the rough washing at the diggings, and to send the gold-impregnated sand here for the more perfect separation of the ore by chemical appliances. The notice of the apathy of the natives in the face of gold digging operations must be received *cum grano.* It would be difficult for the natives to please the *Times* Editor. If they look on, they are apathetic; if they charge the market-price for their fowls, they are extortionate; and if they rushed to dig, we have no doubt they would get abused for their cupidity. Government, however, has taken care that the natives shall be deprived of all encouragement at least to dig for the enrichment of themselves or the country. From another account in the *Times* we quote as follows:—

"The original discoverer, William Rradley, more commonly known among his comrades by the gentler name of 'Bill,' is according to his own account, a native of Middlesex, and has spent many years in the gold-fields of California and Australia, by turns 'prospecting,' and taking part in the still more lucrative pursuits which invariably follow in the wake of the diggers. From Australia he shipped in the 'Martin Luther' for this port, and, not as the *Observer* has it, took a few days' leave, but obtained his regular discharge, owing to a difference with the captain on account of a proposal to reduce his pay from £12 to £4 per mensem for the remainder of the voyage. Two or three from his own ship followed his example, and being struck with the similarity of this country to the gold districts of Australia and California, they turned into the fields off the Kandy road, when, under Bill's guidance, with their clasp knives and a tin basin, they found a few specks of Gold.

"Inspirited by their success so far, they returned to Colombo for supplies, and being soon after joined by four others, who, in like manner, obtained their discharges from the "Faithful," they started on a second expedition. By the direction of the school-master at Weweldeniya, when enquiring about the large rivers of the place, they struck upon the Maha-Oya, and following its course upwards for a considerable distance (with the exception of one who turned back), they at length halted at a spot about four miles from Ambepusse, on the further bank of the stream."

The Observer's Gold Intelligence.

A personal inspection of the so-called "Diggings" has added but little to the previously established fact as to the existence of gold. It may, and probably will be found in sufficient quantity to pay when operations have fairly commenced; but as yet nothing of the sort has been accomplished. The seven sailors, who are a happy, well-conducted set of men, and are taking things easy, have raised and washed about 300 or 400 cubic feet of gravel and stones, from which they say they obtained about an ounce at least (judging by guess) of gold, which they have given away to different persons—principally for Government. On Monday morning we witnessed the washing of 16 buckets of gravel, done at the request of the Government Agent of the Western Province, and which produced half a grain weight of gold: and on Tuesday morning 12 baskets washed for ourselves yielded about the same quantity, but containing the largest specimen that has yet been seen—about the size of the half of a small pin's head flattened. We have also this morning seen an unmistakeable flake of gold washed from a single bason of gravel taken from the bed of the river. Whilst we were at the spot, the men were

engaged in sewing a hose some 150 yards long for the purpose of conveying water from a temporary dam which the natives, at the desire of the Government Agent, were assisting them to construct. When these should be completed, as was expected about Tuesday evening or Wednesday morning, the men intended to set to work in earnest, and entertained the most sanguine expectations of success. They said they considered the appearances more promising than in either California or Australia, for though they might not find large nuggets here, the "colour of the gold" or minute particles were so generally diffused, that experience taught them it was the most profitable soil to work in. In those countries a man, they said, might dig for weeks without "getting the colour," but here it was always present, and would therefore give a constant yield. They had been 7 or 8 days "prospecting" before they selected the spot, but had found "the colour" in several other places, especially in the same river, both higher up and lower down.

The locality is situated just within the first gneiss ranges of the hilly country. The spot they have selected is in a sudden bend of the river, where the eddy of floods has thrown up a quantity of small gneiss boulders, with rounded quartz stones and a quantity of quartz gravel. The bed of the river is over gneiss—the hardest part remaining, but smoothed—the softer being worn out into deep chinks. The stones and gravel lying upon this they wash—especially the sand lying upon the "bed rock," and in the chinks or "pockets," which have to be scraped out carefully with a "pick-axe or knife, as being likely to contain the most gold. The deposit of the metal in these localities, and the effects of washing for it, depend upon the great specific gravity or weight of gold. From the agitation of the water in rivers, it sinks to the lowest point—through quartz gravel, etc., and lies upon the bed-rock; and when the gravel is agitated in the "Tom" and the receiving trough below, the gold in like manner finds its way to the bottom. So also when the residuum sand is taken in a tin dish (or cradle elsewhere) the gold and magnetic iron ore (black sand) fall to the bottom and allow the gravel to be thrown out. The yellow mica, which co-exists in large quantities, being very light, is among the first to be washed away; whilst the black iron ore being of the greatest weight, next to the gold, remains with it to the last. Indeed, so difficult is it to separate these two by washing in a tin dish (the proper method being to mix them with quicksilver, which forms an amalgam with gold), that considerable quantities of the precious metal were manifestly lost in the experiments we witnessed.

The dam is not intended, as is generally supposed, to drain the bed of the river, but merely to gain a head of water to pass along the hose and "Tom" for the purpose of washing. The men say that this will not only save them the labour of bailing up water, but be more efficient by affording a constant and steady stream. When the rains flood the river, they intend to "prospect" the adjoining high land, their hose furnishing them with the requisite supply of water.

Notwithstanding the absurd Government Proclamation, which sensible people will snap their fingers at, we hope all intelligent persons who have time to spare, will at once proceed to the spot and take practical lessons in gold washing, and then return to their several places and go "prospecting," for which they require only a tin dish and a mamotie. To aid young men in their search, we shall in our next give the most recent information regarding gold finding in other countries. In the meantime we may explain that the diggings may be best reached by parties from Colombo going 31½ miles on the Kandy road, when a walk through the paddy-fields (now, however, dry and rideable) of about 4 miles will take them to the spot. Persons coming from Kandy had better start on the walk from Ambepusse, which is about the same distance from "Bradley's diggings." For the information of strangers we may mention that the site of the diggings is at a spot as nearly as possible equi-distant from the maritime and mountain capitals of the island—Colombo and Kandy; being within an easy distance of the splendid road formed by Sir Edward Barnes, which laid the foundation of the coffee cultivation and commercial prosperity of the island, and on which continues

to run daily the first line of mail coaches started in India. Just half way on this road, close to the 36th mile-stone, and little more than 3 miles from the diggings, is the excellent resthouse of Ambepusse, where supplies of every kind can be obtained. Exposure, however, should be avoided, for this beautiful valley of Ambepusse has the reputation of being one of the deadliest spots in Ceylon. The fertility of an existing plantain garden has been attributed to the fact that a whole company of British soldiers perished here from fever. But so it used to be in most parts of the interior until the climate was understood and proper precautions observed. We append a copy of the chemical analysis of one of the first portions of stuff sent to Government :—

DR. ELLERY'S ANALYSIS.

The specimen taken for examination weighing 7½ grains, consisted of some small pieces of yellowish quartz, a black powder resembling coarse emery, and several small scales of a yellow metallic-looking substance. The application of a magnet separated about ⅓ of the black powder which consisted of magnetic iron ore. One-half of the residue was acted upon by boiling nitric acid without effect; the addition of muriatic acid dissolved the metal, yielding a golden yellow solution. This, on the addition of the subjoined tests afforded the following results :—

No. 1.—Chloride of tin, gave a copious, deep purple precipitate.

No. 2.—Solution of sulphate of iron, a dark brown looking precipitate of metallic gold.

No. 3.—A very weak solution of tincture of opium, gave a bright yellow transparent fluid.

I am of opinion from the appearance of the specimen, and from the result of the chemical examination, that it certainly contained gold,

W. ELLERY.

Kandy, March 9, 1854.

P.S.—The Government Agent returned to Colombo this morning, and says that the progress of the dam continues slow and is sufficiently doubtful.

THE MAHA OYA.

The *Times* Editor, writing of the river in which the gold is found, states :—"The Maha Oya is a rocky river throughout its course, and is subject to vast floods in the rainy season. We have crossed it in many places from Maturatta to Allowe Ferry, and it has borne the same character throughout." This is the perpetuation of an error which is natural enough when men go by sounds without consulting maps. The same mistake was made by Cassie Chitty in his *Gazetteer*. There are probably twenty streams in Ceylon called Maha Oya (the great stream), but the river in which our brother laved his weary feet in the valley of Maturatta, in order to reach Allowe Ferry would have to perform a feat unprecedented in the *natural* history of Hydraulics, viz., to cross over or under a larger stream, and to ascend and cross one of the most considerable mountain ranges of Ceylon. The Maha Oya of the Maturatta or Hewahette Valley is a mere tributary of the Mahavelliganga, into which it discharges its waters after a short course, and they are thus disembogued on the very opposite side of the island to that on which is situated the embochure of the golden Maha Oya. This latter rises in the district of Dolosbage, close to the Sentry Box on Raxawa, and falls into the sea about 4 miles north of Negombo, or 26 from Colombo.

The main branch crosses the Kandy road near Ootoovankandy and Fort King, and tributaries cross the road near Kaigalle and at Ambepusse. Close to the main source at Dolosbage is a group of coffee estates, including Allagalla, Barnagalla, Paragallahettia, Madulhena, Nartakande, Raxawa, Windsor Forest, Diahetna, Penylan, Gannetenne, &c.

Important tributaries to this river rise near Gampola and drain the valley of Kaduganava. Amongst the estates which border those tributaries are Judge Starke's, Mount Prospect, Hunugalla Kande, Kakunagolla, Wakatenne, Gadadessa, Kottagalla, Guava Hill, Ambalava, &c.

As the river approaches the sea, we have already shewn that it passes through a group of cocoanut estates. It will be curious if this river should be found to connect by a golden link the two great natural products of Ceylon :—the cocoanut which loves the breezes of the ocean and skirts the coasts, with the coffee shrub which flourishes in the keener air of the mountain zone.

Anti-Gold Proclamation.

The following Proclamation is, we believe, not a hoax, although it is a new proof of the small amount of wisdom with which the world is governed. In this climate we could fancy every possible inducement being held out to parties inclined to go prospecting until nuggets or quantities of gold decidedly remunerative had been found. But Government has done its little best to impede the discovery, and we greatly question whether Her Majesty will at all thank those who have resorted to so curious a mode of asserting her rights :

Notice.

Whereas it has been reported to Government that a small quantity of gold has lately been found near the Maha Oya, on the borders of the Western and North-Western Provinces, and whereas it is expedient that the rights of the Crown to any such gold be asserted and protected, subject to such regulations as may be hereafter made and provided.

Notice is hereby given to all whom it may concern, that the Superintendent of Police has received instructions not to allow any persons to dig or excavate, or to carry on any mining operations under whatsoever name or pretext, with the exception of the seven individuals already so engaged with the cognizance of Government, and of any others that may hereafter be specially licensed for that purpose.

By His Excellency's command,

Colonial Secretary's Office,
Colombo, 14th March, 1854.

C. J. MacCarthy,
Colonial Secretary.

We have good reason to believe that the object of the Government in issuing this Proclamation was not to discourage enterprise, but to prevent confusion and disorder. Nevertheless, we think it ill-judged and premature. At first sight the planters may be inclined to view it as framed in their interest, but it bears another aspect. The issue of a formal and solemn Proclamation by the Government will be by the natives regarded as an "endorsation" by Government of the rumours that a really valuable discovery has been made, and may increase the prevailing excitement and the desire to quit steady employment. Government cannot possibly have meant to interfere with the search for precious stones or the operation of digging for plumbago, and yet the Proclamation seems to prohibit both these pursuits.

Ancient and Modern Notices of Gold in Ceylon.

We alluded in our last to the mention of gold-yielding villages and gold mines in some of the old native records. Further information on this head is embodied in the following Supplement which Mr. Skeen has attached to the Ceylon Almanac :—

Gold and Pearls.

In connection with the discovery of gold in Ceylon, and the alleged existence of a Pearl Bank off Mount Lavinia, the following information may perhaps be of interest :—

Gold is found only in the native or metallic state, but is generally more or less alloyed with silver, in proportions varying from a fraction to 72 per cent. When pure, its specific gravity is 19·25.

It is found sometimes in brilliant crystallized grains, but more generally in small irregular lumps or grains in veins of quartz or calcspar. It is also obtained from beds of micaceous specular iron, in the form of spangles ; in decomposing blende, and amongst iron pyrites. It is, however, far more abundant in the sand of rivers, and in the alluvial deposits of loose gravel, sand and mud, which in many regions are spread over all other strata.

In the East, Borneo, Sumatra, and many other islands of the Indian Archipelago, as well as Cochin China and Siam, are known to possess productive gold mines. Of the productiveness of the Ceylon gold washings little can as yet be stated; but it has long been known to the natives that gold was procurable; and by the kindness of L. de Zoysa, Esq., Mudaliyar in the translator's department of the Colonial Secretary's Office, the subjoined extracts from two ancient Singhalese works on the geography and products of the Island are made public.

From these works, entitled Kadayimpotta, it appears that formerly the whole Island was divided into three great Provinces, called Māyā Ratta, * Pihitty Ratta,† and Ruhunu Ratta‡. These were sub-divided, Māyā Ratta into 28, Pihitty Ratta into 14, and Ruhunu Ratta into 14 Rattas, or smaller Provinces.

In describing the various Rattas in the Province of Māyā Ratta, one writer mentions, among others—*Siduruwana*, of which he says, "This country is so called from the number of streamlets, lakes, and rivers which abound in it. There are lands in it sufficient for the maintenance of the four constituent parts of an army. There are also in it rice villages, Gem vilages," &c. &c. The Buddhist Temple Lankatilleka Vihare is situated in this District.

From the same author the following notices are extracted:

Kururatta (Allootcoor Corle?). A Pearl bank is spoken of about 6 miles from the Coast.

Pehetigalle (Pittigal Corle?). In this division there is a mine of precious stones called *Siudeya*, also a Sea-port called Mahadampe.

Bèlligalle (Belligal Corle?) Gold, precious stones and pearls are found here.

Dewameratta (situated between two oyas, or rivers, in the Kornegalle District). Silver is here found in a cave.

Merisaru and *Mahavelliganga*. Several mines of precious stones.

The second author, writing in a more summary manner, declares that there were known to exist in Ceylon, at the time he wrote "64 silver and 16 gold mines, one thousand (i.e. a very great number) of Pearl banks, and 100 mines of precious stones."

We have applied to one of the best native authorities as to the possibility of identifying the Belligal alluded to by comparison with present names and divisions, but with meagre success. Our informant states:—

"I am sorry to say that the M. S. in my possession does not give any such satisfactory information about Belligal Korale as will enable us to identify the localities alluded to.

"The only items of information contained in the work are a fanciful and absurd derivation of the word *Relligalle*, from the circumstance that gold (pearl and coral are also mentioned!) as found there, the so-called limits of the district (being four stone pillars on which are engraved the figures of a shield), and the circumstance of a village of the name of *Maldeniya* being there, in which is a Buddhist temple of the same name built by King Sirisangabo. This last fact I think will lead us to the discovery of the ancient Belligalle. *Maldeniya* is a well-known name. I know a Buddhist priest of the name of Maldeniya, who lost a large number of books during the last rebellion in the Kornegalle district. I believe the village is either in the Four or Seven Korles. I have no means of ascertaining it for you now, but any Kandyan of these parts will, I believe, tell you at once.

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* Maya Ratta, bounded on the north by the Dedro Oya; on the east by the Mahawelliganga and the mountains; on the south by the Kalloganga; and on the west by the sea.

† Pihitty Ratta, bounded on the west, north, and east by the sea; on the south by the Mahawelliganga and Dedro Oya rivers; it was also sometimes called Raja Ratta, as the ancient Capitals were situated in it.

† Ruhunu Ratta, bounded on the west and north by the Mahawelliganga, and Kalloganga (or Kaltura) rivers; and on the east and south by the sea. The mountainous portion of it was called Malayaa Ratta.

"The copy of *Kadagim Pottu* in my possession is a very imperfect one. I have already discovered a palpable mistake as to the number of smaller provinces into which Pehitty and Ruhunu Rattas are divided in the information I gave to Mr. Skeen. I am endeavouring to get a more correct copy. Should I glean any more information on the subject that may be interesting, I shall communicate it to you with great pleasure. But I fear, however, any information we may get from these sources will be more *curious* than practical or useful."

Soon after receiving this note, a gentleman from Kornegalle entered our office, and in answer to our enquiries stated that the Village Maldeniya was in the Seven Korles and not far from Kornegalle. The Belligal Korle, however, lies in the adjacent district of Four Korles. He promised to make further enquiry and to favour us with the result.

Subsequently our correspondent wrote as follows:—

"Belligal Korle is one of the Four Korles composing the district called 'Four Korles.'

"I am not prepared to say whether the limits of the ancient *Belligala* accord with those of the present Belligal Korle. It is sometimes called in the M. S., '*Belligal Raggaya*' or 'Kingdom of Belligala.' It is therefore probable that it was one of those small principalities into which Ceylon was divided in ancient times, and was more extensive than the modern Belligal Korle. Perhaps it included part of the Seven Korles as *Maldeniya*, (which I *believe*, situated in the Kornegalle district) is mentioned as one of its villages.

"If the information given in the *Kadayim Potta* can be relied upon, it is more likely that gold may be found in *Siduruwane*, which is said to have contained *several* gold mines—*Siduruwane* is supposed to be the modern district of *Yattinuerre* and *Uddunuerre*. The temple *Lankatileka* is situated there."

On turning to Turnour's Translation of the Mahawanso, we find gold mentioned in connection with the name of the celebrated Singhalese monarch, Dhutagamini, who flourished B. C. 158, and who planned the great Ruwanweli [*Ruwanwelle*,—Gold Plain,] Dagoba or Thupo at Anooradhapoora. The people were suffering from the recent war, and "compulsory labour" was a bad resort, so he took to meditation; and "the tutelar deity who guarded the canopy of dominion" and the "Dewos" took the matter in hand and supplied the materials miraculously. We are told that:—

"In a village named Acharawattigomo, situated three yojanas to the north-east of the capital, on a space of ground sixteen karrissa in extent, golden sprouts of various descriptions sprung up, in height one span, (with a root) one inch under ground. The villagers discovering this ground covered with gold, taking a cupful of this gold and repairing to the King, reported (the circumstance.)

"At the distance of seven yojanas, in the south east direction from the capital, on the bank of the river (Mahawilleganga) in the Tambapitto division, a brazen metal rose to the surface. The villagers taking a cupful of these brazen sprouts and repairing to the Raja, reported the circumstances.

"In the south-east direction from the capital, at the village Sumanawappi, distant four yojanas, a quantity of gems rose to the surface: among which there were intermingled the cinnamon stone and sapphire. The villagers taking the same in a cup, and repairing to the Raja, reported the circumstance.

"Eight yojanas to the southward of the town, in a cave called Ambalattikolo, silver was produced."

Under this disguise of fable the historical student will be at no loss to discover the germ of a fact. Either the discovery, at this particular period, of native gold, or its renewed application to the purposes of architectural adornment, gold coins were current in ancient days and the metal itself must have abounded in Ceylon, if we may judge from a description of the city of Anooradhapoora in its glory, as quoted by Forbes from a native record:—

"The magnificient city of Anuradhapura is refulgent from the numerous temples and palaces, whose golden pinnacles glitter in the sky. The sides

of its streets are strewed with black sand, and the middle is sprinkled with white sand; they are spanned by arches bearing flags of gold and silver; on either side are vessels of the same precious metals, containing flowers; and in niches are statues holding lamps of great value." Sir John Mandeville, who wrote in the Fourteenth Century, stated in regard to Ceylon, amongst other great marvels, that "There dwellen gode folk and reasonable, and manye Cristen men amongst hem, *that ben so riche, that thei wyte not what to done with their godes.*" Perhaps this may have to be recorded of "reasonable folk" in Ceylon yet. Cordiner, whose work was published at the beginning of this century, states :—

"Crystallized pyrites, which contains a little copper, is manufactured into buttons. Quicksilver has been discovered in small quantities. The Candian territoyries are said to contain gold, but the working of the mines, or gathering of the dust, is prohibited by the prudent policy of the King."

Percival, who wrote about the same period, mentioned the discovery by Colonel Robertson of a quicksilver mine at Cotta, which had been previously worked by the Dutch, but which fact they had concealed from the British. Bennett gives the following statements and opinion :—

"In Ptolemy's account of the island, plumbago is included with iron and copper as indigenous; and in the year 1681 Knox mentions the former as a native mineral; it is further recorded, that in 1755, a Cornish gentleman, of the name of Thomas, discovered the presence of tin ore in the island, and, subsequently, found as fine a specimen of it as he had ever seen in his native country, that Mr. Ive (the author) had also found there veins of black crystal intermixed with spar and iron, and black lead and copper ores."

To these statements, Dr. Davy thus opposes his opinion in rather an unqualified manner. 'Wherever I have been amongst the mountains, I have sought more particularly for tin and copper, but in vain, having never observed the least traces of either, or of lead. It has been asserted in some publications that gold and mercury occur native in Ceylon. The result of the inquiries I have made, satisfy me the assertion is unfounded, and that neither metal in any state has yet been met with in the island."

Now, as Dr. Davy was altogether not more than three years and a half at Ceylon, (during nearly one-half of which period the Kandyans were in rebellion, and he himself physician to the forces), one would suppose that, even with his known ardour and scientific acquirements, an area of 24,000 square miles was rather too large for so minute an investigation of its geology, as would warrant the doctor's assumption that the statements of his predecessors (in authorship upon Ceylon) are groundless; and should further investigation and consequent development of its mineralogical resources nullify Dr. Davy's opinion altogether by the production of gold, silver, lead, tin, copper, and mercury, how deservedly will the tables have been turned.

The late Mr. Reckerman, Fiscal of Colombo, informed me that coal had been discovered in the island by the Dutch; but from there being such an abundance of wood and charcoal, the only fuel used by the native cooks, no notice whatever was taken of the discovery. That mineral is now become an object of such great and general importance, as to be worthy of the most particular research for the purpose of supplying fuel to steam vessels, touching at Ceylon, on their voyages to and from the colony that discovery has ever produced.

It is therefore to be anticipated, that malgré prejudiced opinions to the contrary, mineralogists may yet be induced to turn their attention to the devolopment of the geology of this magnificent couutry; for there can be little doubt that it will increase the present number of its known mineral productions, if it do not include both gold and silver.

Dr. Gardner's opinion in 1847 was as follows :—

"With regard to the existence of metallic veins in the mountains of Ceylon, almost nothing is known. Traces of tin have lately been said have been met with; and it is not at all unlikely that it may hereafter be met with in greater abundance, as it is principally in the metamorphic rocks that metallic veins

are found to exist; and mostly in mountainous countries or their immediate neighbourhood. As their existence, however, cannot be predicted, further knowledge concerning them will only be obtained by actual examination of those parts of the island most likely to possess them."

In 1849 Dr Gygax reported professionally on the district of Saffragam, stating that he had discovered ores of tin, nickel, cobalt, iron, with anthracite, and we believe expressing his conviction that gold would be found, but we are not able at this moment to refer to his report.

(From the *Colombo Observer*, March 20, 1854.)

REPORT OF DR GYGAX ON THE GEOLOGY OF SAFFRAGAM.

We have now had an opportunity of perusing the reports made to Lord Torrington's Government by Dr. Rudolph Gygax, who was employed in 1847-8 as Colonial Geologist, and sent to report specially on the district of Saffragam in the southern part of the island, where gems have always abounded, and where the greatest mineral wealth was always thought to exist. This district includes and lies around the base of Adam's Peak, and its chief town is named Ratnapoora, "the City of Rubies." Much to our disappointment we find that Dr. Gygax says not one word of gold, he does not seem even to have recognized the possibility of its existence, not a word about silver, copper or tin in these reports. There is however a great deal about iron which, after all, if India and Ceylon are to be traversed by railways, may be of more importnance than the more precious metal. In consequence of the large demand, iron has risen so high in England, and the expence of freight has also increased so greatly, that the East India Railway Companies are offering every possible encouragement to the manufacture of iron in the country. Accordingly, the Iron Works of India have taken a new start, and it is not impossible that Ceylon may yet be engaged in turning out masses of the great civilizer. It seems a dangerous thing to dogmatize. We have always thought it safe to follow Dr. Davy (brother of the celebrated Philosopher) in the assertion that no gold existed in Ceylon, and that iron was to be found only in detached masses. But here come a number of men who know nothing of geology, and they soon afford a practical proof of the existence of gold. Then again, if Dr. Gygax is to be relied on, there is a bed of iron ore in Saffragam, 20 miles in extent, which might be made to yield "millions of tons." Cheap labour would be wanted to convert the surrounding forests into charcoal, for strange to say neither is there in the reports before us one word about anthracite, although Dr. Gygax is said to have discovered it, and although specimens of it collected by him are deposited in the Museum of the local Branch of the Asiatic Society. In these reports although we find nothing said of the more valuable metals, yet Dr. Gygax mentions the existence of a "Mica, coloured like burnished copper" to be found nowhere else, but in that part of the island, and indicating, he thinks, rich deposits of precious stones. This reminds us of a discovery made by a gentleman who unfortunately left for Galle this morning to proceed to India. Mr. Robert Craig, while tracing a road in Saffragam, discovered masses which he believed to contain gold in connection with what appeared to be copper, not green but with the usual copper colour. The bearings of the spot are said to have been fixed, and it was covered up for further examination. A specimen of the substance said to contain gold when first examined by Dr. Lamprey was pronounced to contain nothing more valuable than arsenic. A further examination, however, with reference to the recent gold discoveries, is said to have led to the detection of gold in Mr. Craig's specimen. We speak from verbal information, and of course under correction. Perhaps Dr. Lamprey will favour the public with the result of his observations. If gold should have been found in the specimens, it seems a pity that Mr. Craig should have been allowed to depart without being asked to point out the locality for further research. Although tin ore is not mentioned by Dr. Gygax in his reports to Government, yet he includes it in a list of minerals found by himself, and indicates Saffargam as the locality,

in a paper printed in the transactions of the local Asiatic Society in 1848. This, and the facts quoted by Bennett go to shew that tin really exists in Ceylon, and may yet be found in quantity. The search for gold, even if comparatively unsuccessful, may reveal the presence of metals which exist in the same geological formations, viz., tin, copper and lead. On every account it seems well that the country should be thoroughly explored. The researches of Dr. Gygax were cut short by motives of finance, and he was subsequently forced to seek his fortune in Australia. Thither also proceeded our old friend Major Baddely of the Engineers, who wrote much on the Geology of Canada and Ceylon. He had found gold in the former country in formations exactly similar to some which he saw in Ceylon. We must refer to his letters in our columns to see if he did not actually assert that gold would be found in Ceylon. Such is our present impression. Dr. Gygax, a Swiss by birth and a man who had travelled much, was well qualified for the task he undertook in every way except by an idiomatic knowledge of the English language. Some passages in his report are very amusing, but they are easily enough understood, even where he uses the initials S. O. to indicate a point of the compass. We read South East—his mother German leading the geologist to give the initial letter of *Ost*. We can even fully understood and sympathize with his feelings when he descants on the folly and apathy of the natives of Saffragam in wasting nine shillings' worth of labour and charcoal to produce two shillings' worth of iron ; their process being primitive and barbarous to such an extent that even the experience of a thousand years had not "teached" them to use iron tools. He writes :—

"I must beg leave to accept my apologies for having entered on a field which does not properly belong to my researches, but it is a pitiful sight to see the poor helpless people with all the riches of nature around them," [but turning those riches to no profitable account]. We have supplied the ellipsis, and we hope the day may come when the "pitiful sight" will give way to a scene of well-directed and profitable industry ; when the echoes of the Peak should resound to the snortings of the Iron horse careering over sleepers, made from the iron which extends in rich abundance from Ballangodde far down into the wilds of Bintenne.

Dr. Gygax, in the first of his three reports, begins with the beginning and describes the isolated elevation on which Colombo stands, conspicuous over the flat country and paddy-fields which stretch away around it. This elevation has on its surface from 20 to 40 feet of cabook or laterite (so useful as a substitute for bricks, and as the basis of a rich soil). Below the cabook appears a mass of hornblende rock, with masses and *dykes* of yellow granite. Differing from Gardner and others, who consider cabook as a mere result of decomposing gneiss, Dr. Gygax looked on it as an "ancient alluvial deposit, raised and changed in its physical characters by the rising up of the yellow granite." The "hornblende rock," he continues, "is in some places rich in minerals, as common quartz, rock-crystal, amethyste, fluorspar, calcspar, apatite, feldspar, garnet, prehnite, chiastolith, iron pyrites, magnetic iron pyrite, molybdena, &c. The yellow granite contains about the same minerals, but singularly changed in their colour and crystallization." Much the same characteristics were found as far up as Avisavella, where iron ore occurs in detached masses or embedded in the yellow granite, but increasing towards Ratnapoora. Dr. Gygax, as a general rule, would pay little attention to minerals found in the yellow granite, which he considers "an analagon of basalt," representing in the plutonic formations of Ceylon what basalt is in volcanic formations. Near Ballangodde Dr. Gygax first fell in with rose quartz, but curiously enough it suggested no idea to his mind of the presence of gold. "The road," he says, "goes over a red decomposed granite with large quantities of quartz. Some large pieces of quartz on the road are beautifully rose-coloured. Some pieces have been brought down to Colombo, cut and sold by the Moormen as ring-stones. Large plates of it could perhaps be obtained, and might be turned to some use as small tables." He is of opinion that the red granite, where it occurs, receives its colour from "small strata filled up with manganese and peroxide of iron."

Describing the great variety of minerals found in a stratum of grey granite, he thus notices iron pyrites: "in oblong flat knolls along the stratification of the rock, a few crystallized in very complicated forms; pale nearly silver-white, different from that of the dolomite, which renders an analysis of both desirable." In this same formation Dr. Gygax saw "an innumerable quantity of rubies of a fine rose colour, but all *splitted* and falling to powder." He is of opinion, however, that lower down in the rock, rich and profitable ruby mines might be found, like that mentioned by Sir A. Burnes as existing near Khonduz. He has never, he says, set any value on the secondary deposits of precious stones in the plains, most of which seem now to be nearly exhausted. But who is to mine the hill deposits? Near Pettygallekande he was struck by the resemblance of the formations to others of undoubted volcanic origin. He wrote:—"All these rocks appear together in a great confusion, so much, that I cannot but compare it to the part of a crater. Huge masses of rocks are seen hanging over others like have cooled lava. Having seen the volcanoes of the Azores, I find a strange similarity of this spot to one of the semicraters round the trachytic ridge of Setecidades Island, St. Miguel."

The strata here are "rich in chromite of iron and a fine emerald green mineral, which, I believe, to be protoxide of chrome." This substance might, he thinks, be collected by the natives, and, with the aid of cheap nitre from Bengal, chromic colours, he conceives, could be manufactured in Ceylon.

Dr. Gygax notices that on soil, apparently barren from the existence of masses of lava-like iron stone, the forest trees are rich in valuable gums, dyes and oils. Dr. Gygax enters at large into the native process of smelting, and into the question of improved modes and the prospects of their paying, but our time and space being limited, we must pass over all this at present, and give the curious paragraph with which the report concludes.

"The slakes from the furnace are not without value, they contain a large quantity of chrome and manganese.

"A most singular fact is that in the jungle the slake does not decompose after many hundred years, and near the houses in about 2 years. I am at a loss for an explication, perhaps the influence of animal matter. It is said that the decomposed slakes afford the best manure for paddy fields. This would give a chance to sell the slakes for the sake of chrome or manure, if some means could be found out to decompose it cheap and in a short time."

The reports, it will be seen, throw no direct light on the gold question, but at this moment all that refers to the geology and mineralogy of the island is of value, and will be eagerly looked into until the Gold Question is set at rest. Dr. MacVicar, in his paper recently reprinted by us, mentions that the substance of Dr. Gygax's researches was embodied in an article contributed to the transactions of the local Asiatic Society for 1848. We have looked into the article which consists of lists of minerals, 37 found by Dr. Gygax himself; 9 presented by friends; and 27 obtained from native dealers; with a meagre preface containing a promise, which appears never to have been fulfilled, of giving a description of each mineral. The list of minerals now actually in the Museum of the Asiatic Society, chiefly the result of Dr. Gygax' researches, is thus afforded in the most lately published transactions:—

"The minerals and geological specimens collected by Dr. Gygax in the Saffragam District, forming a large and valuable collection. *Presented principally by Government.*

In this general collection, there are about 100 specimens of Rock Crystal, Hyalithe, Amethyste, Quartz, Zircon, Tourmaline, Disthene, Beryl, Epidote, Hornblende, Mica, Garnet, Spinel, Corundum, Chrysoberyl, Topaz, Apatita, Feldspar, Binnerite, Wolfram, Rutil, Pyrochlor, Ilmenite, Titan ore, Arsenite of Nickel, Hematite, Arsenite of Kobalt, Tin ore, Chromate of iron, Chrom ochre, Molybdena, Iron pyrites, Iron glance, Magnetic iron ore, Iron ochre, Bog iron ore, Anthracite; with about as many geological or rock specimens from the same district.

A collection of specimens illustrative of the geology of Newera Ellia. *From Dr. Kelaart.*

Other specimens of rocks and minerals from other parts of Ceylon; including a specimen of Ceylonite, *from Lieut. Henderson, C. R. R.*

Specimen of iron-ore, from the Matura district.

Specimen of iron found at Galle in digging a well. *From Mr. G. Goonewardene.*

Some iron pyrites. *From C. Whitehouse, Esq.*

Specimens of Fossils. Dr. Kelaart says, "The Limestone in which the Ceylon fossils are imbedded, is of a very compact and pure form. In one hand specimen we observed a fossil phalange about an inch in length, apparently of a large Saurian reptile. This unique specimen is now in the Museum of the Asiatic Society of Ceylon." Dr Kelaart's Zoology of Ceylon, p. x."

Looking at the frequency with which, to the confusion of Geological theories, gold has been found in porphoritic rocks, it is interesting to know that rocks, of this description, were noticed by Dr Gygax near Balangodde.

The Gold Question.

[For the Government License to diggers, see page 3 of this pamphlet.]

The price fixed for a License would not perhaps be too high, if only nuggets of gold, or dust in quantity had been found. But the application of Mrs. Glass's rule in cookery is obvious: "First catch your hare." Government ought to have been satisfied that a source of revenue existed before they attempted to derive revenue from it. We are bound, however, to concede that the preservation of peace and order were objects in view in the issue of Proclamations which are doubtless repressive in their tendency. It will be observed, that although in the sale of Crown Lands, the rights of the Crown to mineral deposits were especially reserved. There is at present no prohibition to private parties to search and mine their private lands. If in searching the quartz beds which, in planting coffee, cultivators so religiously avoided, rich deposits should be found, of course the finders will at once inform Government! The prejudice against quartz in planting operations may go far to answer the question "Why, if nuggets exist, were they not discovered in all the digging connected with 300 estates of 60,000 to 70,000 acres, spread over ranges of hills and streams?" Of course "prospecting" is now going on everywhere, and we think the bed and sources of the Kalany Ganga about Yatteantotte and Ambegamoa ought not to be neglected. We recollect being much struck with masses of beautiful red quartz on one of Mr. Anstruther's estates which we saw in 1849. And it appears from the valuable extracts from Earp's little work which we this day afford, that that gold is generally found in quartz at the foot of the *lower ranges of hills*, such as those of Kaduganava, Dolosbage, Ambegamoa, &c. Our friend of the *Examiner* dwells much on slate formations, but we have none of these in Ceylon. Gold is found in slate formations, but much more frequently and much more plentifully in quartz. Amongst the circumstances which are now revived is the fact that a French cook who was with Major Blackall in Ceylon, used to search for gold in the bed of the Mahavelliganga. He is said to have gathered particles of the metal to the value of £2, but with a result which it is but too probable may attend the present more extensive researches—the quantity of gold found did not pay the labour expended on its collection. The well-known hill near Kandy called Rangalla signifies "the gold mountain," and we are told that the name of a coffee estate in the neighbourhood signifies "the gold mine." Dr. Kelaart, in his recent work on the Fauna of Ceylon, has the following passage:—

"Iron pyrites, magnetic and hematitic ores of iron are abundant in the district. Long before Europeans visited Newera Ellia, the natives used to come up to smelt iron from the ferriferous rocks found here. Gold is also said to have been discovered here."

Our brother of the *Times* however states, in reference to a specimen of red quartz forwarded to him from the mountain sanatarium, that it contains

yellow mica but no gold. The gold must be looked for lower down. To bring together all the information possible bearing on the subject, we reprint below some passages from Pridham's compilation and an extract from the late paper by Dr. MacVicar.

(*From Pridham's Compilation.*)

"From the nature of the rocks other metals might have been expected in Ceylon, says a learned geologist, who mentions that he has sought in vain among the mountains for tin, copper, and lead. All three, however, are reported to exist by persons who have themselves discovered them, and quicksilver and plumbago (kalu miniran, *Singh.*) which of late years has been largely exported to England, may be added to the list. Gold and mercury, which are said to occur native in Ceylon, according to this writer are rarely found, but small lumps of the former have been at times met with. 'Did any,' he continues, 'of the common, and what is more, of the precious metals occur in Ceylon, it would have been known long ago; for the natives are inquisitive and curious, and being in the habit of searching for gems, and collecting everything that glitters, or that is in the least likely to sell, even bits of iron pyrites and ores of iron, it would be very extraordinary were they to pass unnoticed substances more attractive, with the value of which they are well acquainted.' I may cursorily observe that this remark is rather applicable to the natives of the southern, than any of the other provinces of Ceylon, and that the opposite conclusion of another learned geologist, embodied in the note,* is nearer the truth. Dr. Davy's erroneous conclusion on these points must have arisen from the imperfect opportunities at his disposal for the survey of the whole island, not more than one-third of which he ever visited, and not from any want of sagacity in observing, or ardour in pursuing the various branches of natural science. Stahltein, or crystalized pyrites, impregnated with a little copper, is used by the Singhalese for making buttons."

(*From Dr. MacVicar's Paper.*)

"This humble view of Ceylon I take from considering its geological structure, which is such, that it can never give anything better on the large scale than a very poor soil, and which holds out no promise of yielding either minerals or metals worth the mining.

"Hoping, that it might be otherwise, the government of Lord Torrington some years ago, when extravagant hopes of the resources of the island were entertained, appointed Dr. Gygax, an accomplished mineralogist who happened to be on the spot, as its geologist, to explore the country with a view to economic objects. But the result was wholly negative. Except a very friable plumbago which has been long mined by the natives and exported by the English merchant, to line the hold of ships previously to putting in more valuable cargo, such as coffee, nothing of any value was found *in situ*. Dr. Gygax's report is now, doubtless, among the archives of the Colonial Office in Downing Street, and therefore accessible to the naturalists of this country; and the collection of minerals which he made for the Government of Ceylon was very handsomely given by Lord Torrington to the charge of the Ceylon Branch of the Asiatic Society, in whose Museum at Colombo it is now deposited, and where it can be inspected by any one who has an hour to spare. Let the mineralogical traveller prepare for disappointment, however, if he expects Ceylon to realize in any measure the conception of

* "The sciences of geology, mineralogy, &c., in all their branches are but imperfectly understood by the natives, notwithstanding Ceylon is the depository of such an extensive variety of specimens. Their attention seems never to have extended much beyond the valuable gems and the mineral ores. As to a thousand other subjects, both on the surface of the earth and imbedded in the hidden substrata of nature, so interesting to men of science, they have allowed them an almost undisturbed repose, never having exerted themselves either to quarry out a knowledge of their latent properties or ascertain their intrinsic worth."

an island of gems. Dr. Gygax found only thirty-seven mineral species in all, the commonest, such as quartzes, felspars, and mica, included. His results have been published in the Journal of the Ceylon Branch of the Asiatic Society for 1847."

With reference to our extract the other day from the Mahawanso about the gold miraculously produced in the forms of roots and twigs, it is a curious coincidence, and tends to confirm our idea of a real discovery of gold being indicated, that in California gold sometimes resembles twigs. In connection with the report of a case from Manaar contained in the Jaffna *Morning Star*, we find it stated that "among the ignorant, illiterate portion of the native community, a notion is pretty generally held that to ensure success in search of hidden treasure, a human victim must first be sacrificed to propitiate some deity." It is to be hoped that few persons with such notions will be found amongst the searchers on the present occasion.

We find we were in error in our last in giving "Gold Plain" as the interpretation of Ruanwelli. "Gold Sand" is the correct one. The Native correspondent to whom we have been indebted for much information already, writes as follows :—

"*Ruanwelle*, I think, strictly means 'gold sand,' and not 'gold plain.' You are quite correct in supposing that 'Ruanwelli dagob' means the "dagob covered with dust."

"Ruanwelle is situate in Three Corles, and cannot be the place mentioned by Turnour.

"Ruanwelli dagob is the well-known dagob of that name in Anuradhaporre.

"A detailed account of this temple will be found in the Thupawansi. I shall look into it, and see if it contain any information that may prove interesting on the subject of gold.

"I remember reading somewhere that the *Ruwanwelli* dagob was so called from its having been covered with gold or gum-dust (*Ruwan* also means gum). I thought the passage was found in the *Thupawansi* (History of Thupas or Dagobs), but on taking a hasty glance of the work last night I could not find the passage. According to popular tradition, the Ruwanwelli dagob was so called, because the *gods caused gold sand to be strewn* on the square of the dagob in the days of its consecration.

"It is known in Pali Historical Records by the names of *Hema mali*, *Ratana mali*, *Sonnamali*, *Ratnawaluka*, Cheteya or Thupo. They all signify *gold-sand* or *jewel-sand* dagob. The term also might mean 'gold-mountain' or 'jewel-mountain.' The author of the *Thupawansi* in his introduction says, 'I proceed to relate the history of *Ratna Mali Cheteya* (gold or jewel sand, Cheteya) which is refulgent with a vast mass of gold, jewels, gems, &c., &c.'

March 20, 1854.

I have this morning seen a native of Hapitigam Corle, who tells me that there is a hill as well as a village of the name of *Maldeniya* in that Corle, and that the distance from that village to the "diggings" is only about 1½ or 2 miles. I also learn from him that the distance from Maldeniya to Belligal Corle is about 6 or 7 miles. I have also heard that Maldeniya Unanse, although resident at present at Kornegalle, is a native of Maldeniya in Hapittigam Corle.

We have been endeavouring to identify the places mentioned in the Mahawanso, where precious metals, gems, &c., were found, but, for want of a good map of the country surrounding Anooradhapoora, with but indifferent success as yet. The gold seems to have been found in Bintenne and the silver in Saffragam We hope to pursue our researches on this subject. The intelligence from the diggings, as far as it is certain, is unsatisfactory. Gold continued to be found, but not in remunerative quantities. A gentleman who visited the scene of operations on Friday, writes :—

"We found the men (except two laid up with fever) digging out the sand from what is the river bed in wet weather, placing it on an inclined board with an iron grating at the end to receive large stones, all the earth and sand falling into a box with three compartments. Into the first of these

the one under the Tom, the gold falls; when full, all the sand and stones contained in this box are washed by hand in a large flat tin pan. I saw the best day's work that has yet been done after 8 hours' labour assisted by coolies, and in every possible way they got four dwts. (penny weights) value 15s., so these diggings will not in my opinion do. That there is gold to be had in quantity they have yet to prove, and Power, who is appointed *Gold Commissioner*, started this morning with Bradley and another to prospect up the country, taking Gordon's bridge, so the diggings may approach Cotta Galle. That there is gold in the Maha Oya at the old Morrotie ford I've not the least doubt, only if it pays to wash it; to Natives it may, but at present decidedly not to Europeans."

Mr. Power, we understand, wrote in to Government on Saturday to say that "a piece of gold" (size and weight not afforded) had been found 8 miles above the diggings, "with more to come." We hope to hear further before going to Press.—The fact of two of the diggers, being down already with fever, is ominous, and we have heard that some sailors who had left their ships have asked to get back again.

Henry Temple, one of the diggers, has just been in our office with a companion who is very ill from fever. He demurs to our suggestion that the diggers are likely to find more fever than gold, and at our request gives us as follows the names of the now historical seven, rendered famous by the exception made in their favour in the Government Proclamation, Henry Temple, Wm. King, Charles Langley, James Mabley, John Wilson, John Philips, Wm. Bradley.

Thirty of the police force are already at the diggings, and we have heard that a company of the Ceylon Rifles are under orders, if required for the same destination.

P.S.—Since writing the article on the reports by Dr. Gygax, we find that there was a subsequent Report, dated Jan. 1849, in which he announced the discovery by him of gold in connection with iron pyrites. Another fact is that Mr. Talbot, the Government Agent of the Southern Province, has forwarded to the Colonial Secretary what appears to be a nugget of gold, but which bears the appearance of having been hammered. The native who presented the piece of gold to Mr. Talbot states, that he found it in the state in which it exists near Ratnapoora. Then it seems that gold actually does exist in the rocks at Newera Ellia, and that specimens are about to be analyzed to settle the quantity. And finally, a letter from Kandy asserts that 24 miles from that town on the Trincomalie road, gold has been found in larger quantity than at the original diggings.

We now find that the piece of gold reported by Mr. Power was produced to him by a headman—that Dr. Ellery pronounced it to be entirely *without alloy*—that it was found at the Village Dambedeniya (an ancient capital, where coins of gold and copper were formerly struck)—and that the headman had promised to return with more specimens and with the persons who had found them!

GOLD FINDING AND GOLD WASHING.

At the present juncture we believe we cannot better meet the wishes of a large portion of our readers than by presenting them with the following clear and simple directions for finding deposits of gold and separating the metal where it does exist from extraneous substances. We quote from *the Thirty-fifth Thousand* of a little work entitled "The Gold Colonies of Australia," by G. B. Earp :—

How to Look for Gold.

The first step toward this is to inform him [the Emigrant] under what conditions it is found in the principal gold countries of the Northern Hemisphere, to which the precious metals have, for the most part, been heretofore confined.

In the mines of Russian Siberia, gold is found mixed with sand and

coarse gravel; the sand being evidently a disintegration of quartz. Pebbles of the latter substance, when broken up, yield it in considerable quantities, and in lumps, answering to the "nuggets" of the Australian mines. The hundredweight nugget, of which we have spoken, was an immense quartz boulder of this description, and this is the most common form of gold nuggets in Australia.

It is also found in granite, schists, and other igneous rocks. This is experienced in Australia. It is plentiful in Russia, where greenstone, porphyry and serpentine are found in the older limestones. In this case, it is often associated with platinum and chromate of iron. The gold-bearing detritus is not so universal as in Australia, but is found at intervals.

In Brazil, gold is found in primitive granite, gneiss, hornblende, and mica, or, rather, in a disintegration of these rocks, as it exists generally in a stratum of these resting on the rock. As in Australia, it is frequently found on or at a few inches below the surface. Sometimes it exists in scales, or lumps, mingled with sand, both in the beds and on the banks of the stream, as well as in grains in alluvial loams. All these forms of gold exist in Australia, as is apparent from what we have before stated.

Sometimes gold is found in South America, mixed with the sulphurets of silver and iron, and again traversing rocks of mica slate. In Peru, ores of iron and oxides of copper contain gold in large quantities. In the bottoms of gullies, filled up by the accumulation of sand, nuggets of some size are often met with. This is precisely the case in Australia.

In Europe, gold is sometimes found in flakes, at some distance below a sand or gravel bank, and is often accompanied by titaniferous iron. It is seldom worth working, and is thus found on the banks of the Rhine. The Spanish mines, once highly productive, are mostly composed of ferruginous sand.

African gold is usually found in the sands of rivers, only, perhaps, because the people are not sufficiently intelligent to trace it to its matrix. Asian gold is generally found under the same conditions, probably from the same cause.

California is perhaps the gold district, the geological features of which most closely resemble those of Australia. We have stated elsewhere that Mr. Hargreaves, the practical discoverer of Australian gold, was so struck with the resemblance of the California mountains to the outlines of the Australian Blue Mountains, that he returned to prosecute a search for the precious metal, and found it as he had anticipated.

In California, the interior mountains are composed of porphyry, limestone, &c.; these forming the outlying spurs, beyond which the rocks are volcanic, shewing lava in some places, and being covered by loam. On the Pacific, granite appears with schists and metamorphic limestones; these are traversed by veins of quartz, containing gold. Humboldt says that the prevailing geological types of equinoctial America, of which California is an extension, are porphyroid rocks associated with trachytes; and these, though in opposition to scientific theories, contain abundance of gold. Some of these porphyry formations rest immediately on primitive rocks, others on clay or talcose slate, with transition limestone. These porphyries are rich in gold, the detritus of similar rocks.

As a general rule in searching for gold in Australia, the rocks should be either quartz or quartzose, though it is often found in clay-slate and other rocks previously mentioned. It is sometimes found in quartz of a rusty appearance, from the mixture of iron; the mass is then frequently cellular or honey-combed, as was the case already recorded of Dr. Kerr's hundredweight of gold. Granite rocks often contain auriferous veins of quartz, and when this is the case in Australia, gold may be expected from the granite itself. Gravel itself is a detritus of quartz, and hence the gold is frequently found amongst and *beneath* gravel. When schist rests on granite it is often auriferous, the gold being scattered in particles in the clayey rock.

In Australia, it is found, as a general rule, that when smaller particles of gold are found in a stream than they are higher up, the stream should be traced

still higher, when the matrix will be arrived at, the river itself having brought down the detritus. The sources of gold are found to be two-fold; the metal has either been diffused in certain rocks which have decomposed, or has been spread over the surface of the hills at some remote period, by the violent action of water. This is the origin of all alluvial gold beds.

Contrary to the usual law of metals, where gold is concerned, it is the upper and not the lower portions of veins which are prolific. This arises from the violent action of water on the surface,—and hence, in general, arises the argument that there must be mountains to produce much gold in valleys. It is generally found, moreover, that moderately high mountains produce the most gold. The most prolific gold-fields of Russia are at the base of hills not more than 1,500 feet high whilst those at the base of hills rising to 5,000 feet and upwards are not nearly so prolific in gold. Hence it is probable that the most fruitful discoveries in Australia have yet to come, and the gold-fields of Port Phillip are a direct proof of the argument, as the hills where gold has chiefly been found are of moderate elevation.

A brief notice of the distribution of gold generally will be of use to the intending emigrant,

The diluvial deposits are found in the beds of streams and in the valleys around, the latter having been at one time covered with the waters of the stream. Gold is also deposited in a limited height above these valleys—frequently to the summit of the higher lands in the neighbourhood, these having been at some remote period under water also, when the gold was deposited as in the streams. The metal, under these circumstances is found in sand, gravel, on clay beneath the gravel, and amongst the debris of rocks, and is continuous as to its quality and frequently as regards the given contents per cubic fathom. Diggings where the deposits are of this nature are the most productive, and reward the most unskilful miner; no machinery beyond a cradle, or some equally simple contrivance, is requisite. The materials for carrying on the pursuit are easily procured—the returns quick—and the whole establishment is readily removed as the gold becomes exhausted.

Much of the gold found in these diluvial deposits is wasted from the rude manner in which it is sought for; the miner being unable to detect it except in lumps or scales which are palpable to his eye. In Australia, numbers of reputed exhausted diggings will be well worth going over again with more skilful appliances, and the labour will be comparatively easy, from the previous loosening and removal of the earth from its bed.

The gold has not been generated in the streams, valleys and high lands, over which it is scattered;—but has been washed down from the primary or non-fossiliferous rocks, the most common of these gold-bearing rocks being quartz, granite, or porphyry, and sometimes slate, the gold soil of the lower lands being merely the *detritus* of the primary formations.

The intelligent miner will hence look for the seat or matrix from which the gold has been carried—not by itself, but imbedded in rocks which have subsequently been abraded and washed away by the violence of the floods, the gold itself, from its weight, remaining nearly on the same spot in which is finally parted from its rocky envelope. The veins and beds in which it is originally found, generally exist in mountains of secondary height, and these are the more likely to contain gold, the more they are parallel to the meridian. Under these circumstances it is found imbedded in the rocks, often in a state imperceptible to the eye, the nuggets which are found being no doubt the result of fusion of the primary rocks when the latter were in a state of ignition. Rock mining can only be carried on successfully by machinery of various kinds, as pumps, stamps, &c.; and this machinery, being of a costly nature, must be permanent, so that great judgment has to be exercised as to the productive qualities and extent of the gold-bearing rocks, as a large outlay must be made before any profit can arise. Even at the best, gold veins are of a temporary nature, as a few years' continuous labour exhausts the product, and it is now well known, that in the majority of veins, at very moderate depths, the gold gradually and regularly diminishes in quantity,

though in some cases it improves slightly in quality, yet at last the expense of producing the metal is greater than the yield. The history of old gold mines does not prove the veins to be entirely exhausted, but only that the gold exists in such small quantities, that a gradually-increasing loss arises upon each ounce of gold produced, from the increased expense of pursuing the vein deeper.

Gold mines are, however, found extensively in the primary formations, in which the metal is sometimes intimately mixed with the rock generally, or it may be in lodes or veins spreading about like the twigs of a tree, sometimes thick and sometimes scanty, so that the search for it is not only tedious, but highly expensive, from the great mass of rock which has to be reduced to powder in order to obtain a small quantity of gold. It is for this reason that the gold mines of the Merionethshire and Wicklow mountains are not considered worth working. Indeed, although gold veins are worked in many countries, it is only in California that the gold rocks have been found worth working on a large scale, and even in California the sums spent in the unsuccessful attempts at rock mining are very large, as some of the English companies formed for that purpose can testify.

It is then to the rivers or to the action of water generally that we have to look for the most profitable supply of gold. Instead of hard rock, soft sand has to be scratched, and the search is often rewarded—in Australia beyond any other gold country—with bunches and lumps of the rich metal, varying in value from a sovereign to 4,000 sovereigns, while lumps of the value of a hundred sovereigns, or more, are common prizes.

Gold is again found overlying the diluvial deposits in recent earthy matter, and has been slowly and gradually brought into the valleys and streams by the action of rain torrents, &c., in the neighbourhood of auriferous beds; and not always in the neighbourhood of these only, but gold-bearing rivers are frequently beyond the primary formations. Gold, under these circumstances, is the mere concentration of many ages, by the action of water on earthy and ferruginous soils, which for hundreds of miles may contain traces of gold throughout, but yielding so small a percentage per ton, that by no known process of extraction can it be rendered available. Some of the states of North America, Mexico, and Brazil contain gold under those conditions, but hardly worth the working; the object being not so much to find where gold exists—for next to iron it is the most abundantly distributed metal—but to find where it exists in quantities sufficient to repay the labour of gathering it.

The last condition under which gold may be expected to be found is the one before alluded to, viz., in previously-worked alluvial and diluvial deposits, in which, from imperfections in working or washing a portion escapes, which, from its specific gravity, settles in the earthy contents of the workings and rivers, and as the earthy matter is annually washing away, while most of the gold remains, after a lapse of time the working of such localities over again will be found to be profitable. But as new fields in Australia will be abundant for ages to come, we need not pursue this matter further.

The great gold desideratum of our day is a solvent which shall loosen the metal from the rock without the tedious and expensive process of pounding, separating the gold from earthy matter with less loss than is at present the case. The various amalgamating apparatus are too tedious for poor ores, and unnecessary for rich ones. The well-known simple affinity of mercury for gold will secure the smallest particle; but unless water be abundant, and something like 200 grains can be obtained per ton of earth, it will not yield any profit worth notice.

It has generally been found that at a distance from the mountains in which auriferous streams arise, there is a point in which the gold is nearly an impalpable dust, and that on going up the stream the particles sensibly increase in size, till at length they assume the appearance of scales; higher up still, the metal increases in coarseness, till the gold is found in its natural roughness as if fresh broken from the matrix, being more or less interwoven

as it approaches its source. As it approaches this, pieces are found to which portions of the native rock are attached, so that by carefully marking these indications, the shrewd observer is able to form a good guess of the vicinity of mines which will amply repay the acuteness of his observations.

Our space will not allow us further to enter into geological considerations, and we will now give the reader a few mineralogical characteristics of gold, so that he may know it when he finds it, this not being so easy a matter as he may imagine. False alarms without end are of constant occurrence in all the Australian colonies, the discoveries turning out neither more nor less than pyrites of some kind.

Gold is yellow, nearly silver-white, and steel-gray; the yellow is the most common in Australia. Its lustre is shining which is increased by a little rubbing, when it will not again tarnish from its non-oxidable qualities. In colour and lustre it may easily be mistaken for iron or copper pyrites. A cut with a knife or a blow with the hammer will at once rectify this mistake as it is soft, whilst iron pyrites is harder than steel, and if struck it flattens, whilst copper pyrites is not malleable, but crumbles before the blow. Mica is again often mistaken for gold, but the weight of the latter will at once point out the mistake, as mica is light. The steel-gray gold may be mistaken for platinum, but as it is rarely found in this condition in Australia, the difference is unimportant, and can only be detected by experience or assaying. The softness and the weight are the best tests. It is softer than iron, copper, or silver, and harder than tin and lead. Hence it is scratched by the three former metals, but scratches the two latter.

When broken, the edges are uneven. It is sometimes found in a crystalline form, and when so, its value is much increased, as being a rare mineralogical specimen. Sometimes it occurs in thin leaves. Should all the above indications not prove satisfactory, the blow-pipe, with which every emigrant should provide himself, is a sure test. Before this it fuses readily, and remains unaltered, whilst copper and iron pyrites have a sulphurous smell and rapidly diminish.

A bottle of nitric acid is a sure test. If the mineral found be gold, it will not touch it; if a baser metal, with the exception of one or two not commonly found in Australia, violent action takes place and gaseous fumes arise. By this means spurious gold dust may be detected: if it be pure, no action whatever will take place, and the liquor will not be discoloured; if impure, violent action will take place, red vapour will arise, and the acid will be discoloured.

The weight of a lump of quartz as estimated by poising it in the hand is generally sufficient to determine whether it contain gold or not, quartz having a specific gravity of about 2½, whilst the specific gravity of gold is from 18 to 19. This accounts for gold being found in grains and nuggets—the water having had sufficient power to break up and wash away the lighter rock, but not the gold itself. Hence it may be inferred that when large lumps of gold are found, the matrix itself cannot be far off—from the impossibility of the current washing these to any great distance. On the other hand if the gold be in dust or scales, it may be, and is frequently distributed over a large space of ground.

The unpractised miner is apt to take several substances for gold which have no alliance with that metal. The first of these is yellow mica: this may, however, be readily distinguished by its lightness. The next is iron pyrites. This is as easily distinguished. Stick the point of a penknife into a scale of gold, and it will penetrate it, but the pyrites would be found too hard for this. Place a little of the substance on a shovel, and put it on the fire. If it be pyrites, a strong smell of sulphur will be perceived, and the residuum after the sulphur is driven off will become red iron rust. Dissolve the mineral in muriatic acid, and add a few drops of nitric acid. Add to the solution a little hartshorn, and, if iron pyrites, rust is precipitated. With a solution of nut galls common ink is produced. With prussiate of potash Prussian blue is formed. Any of these tests will decide between iron and gold.

Should a lump of quartz be suspected to contain gold, the fact may easily be established as follows :—Pound the quartz finely—the finer the better. Boil this for a considerable time in an equal mixture of nitric and muriatic acid, filter the solution through linen or cotton. It will destroy these, but that is no matter; the experimenter must also be careful not to get any of the acid on his clothes, or it will destroy them. If he burn his fingers with the acid, he will not do so a second time. Now add carbonate of soda to the solution when cool, and this will precipitate all baser metals. Filter again, and add a solution of oxalic acid till it ceases to effervesce. The gold will now be thrown down in the form of a black powder, which may be converted into the usual form by melting.

We will now notice a new process for separating the precious metal from black sand and quartz, which has been patented in America. When quartz is stamped, it is found by experience, that from the softness of gold, a great portion of the laminated filaments are rubbed off, sometimes amounting to from one-fourth to two-fifths of the metal; and this filament can never be detached from the iron and sand by any plan of amalgamation. The patentee, who has taken his idea from Dr. Percy—who propounded much the same thing in a paper read before the London Chemical Society—uses neither more nor less than a fresh and liquid bleaching chloride of lime. The mode of its action will be readily understood from what we have before stated, and the ingenious miner can easily try the effect of this hypochlorous solvent for himself.

As gold readily melts, it may be thought that, by heating a piece of quartz beyond the melting point of gold, this metal will flow from the quartz. This is not so; the gold will be melted, it is true, but it will be in the matrix as before. The quartz is infusible, and in order to get at the gold, it is necessary to render it fusible. If to finely-powdered quartz we add several substances, this effect will be produced. Mix carbonate of soda with the finely-powdered quartz, and when it has arrived at a certain heat it is quartz no longer but melted glass, through which the gold, if any, will sink to the bottom of the crucible.

But suppose the gold and quartz to be melted, the same difficulty presents itself as to how to get gold from the quartz-glass which has been formed. We must have recourse to something which will take the whole of the gold from the glass, and which will readily give it back again in its pure state. This condition is answered by mixing with it a quantity of lead. This metal takes up all the gold, and may be readily separated from the quartz-glass. We should here remark that lime and oxide of iron, as well as some other substances, will convert the quartz into glass as well as carbonate of soda. Into the nature of these it is not necessary to enter, as we are only showing the principle of gold smelting, leaving the miner to apply it in practice.

Having now got our mixture of gold and lead, the quartz-glass may be taken from the crucible and thrown away. The remaining step is to separate the gold from the lead. This is done by a process termed "cupellation." The miner would scarcely have time or experience to effect this process, but it will not be uninteresting to him to know its principle. When lead is heated to a high temperature, it rapidly absorbs the oxygen of the atmosphere, and, if heated to redness, the oxide thus formed, melts. But gold never oxidises, and cannot be volatilised at any heat procurable in an ordinary furnace. This distinction in the properties of the two metals causes their easy separation. Many substances readily absorb melted oxide of lead, amongst which is bone-ash, which substance, compressed into as solid a state as possible, will take up all the lead and leave the gold behind; the lead also, if in sufficient quantity, taking with it all baser metals, leaving the gold pure, or alloyed with silver only, and we have previously given the method of separating this. We may, however, mention, that when silver is to be "parted," as it is termed, from gold, the latter must be melted with three times its weight of silver, and then hammered or rolled out thin before it

is exposed to the nitric acid, which dissolves the silver and leaves the pure gold behind.

In powdering the quartz, the process is rendered quicker by making the quartz red hot, and then plunging it in cold water. If the quartz, as is sometimes the case, contain magnetic iron, dry the powdered mass thoroughly, and apply a good magnet, which will take out all the iron, and thus save an immense trouble in getting the gold pure.

Gold Washing.

From our previous extracts it will be seen, that so abundant is gold in some parts of Australia, that it has repeatedly been obtained by a kick of the foot, and by boys and men with a tin dish. These modes are, however, too primitive to be profitable, except accidentally so. A tin dish is no bad test of the soil when "prospecting." Wash the soil, pouring carefully away the mud, leaving the heavier portion at the hinder angle of the pan. Then amalgamate the residue with a little quicksilver. If there is gold, the quicksilver on kneading it will become solid, and form a pasty mass. If the quicksilver remain liquid, and in globules, there is no gold—try again.

The Hungarian method of separating gold would answer well in Australia, where for the most part the gold is coarse and heavy. Get a long broad board, grooved longitudinally, and nail a thin strip of wood all round it, except at one end. Nail also a few strips of wood across the inside of the trough, to stop the gold, whilst the soil washes over. Give the trough a slight incline against a bank, and put your gold earth at the upper end. Pour water over this, and if there is gold it will all remain from its weight in the upper grooves, whilst the soil being light, will be washed away. Where people work independently, as in Australia, and gold is coarse, and water plentiful, this method, simple as it is, would be a very efficient one.

The following is just as simple and efficacious. Carry with you a large wooden bowl, and put into this, or dig out of the bed of the stream with the bowl, a quantity of earth; stir this well in the water, and let it rest a minute or so; then throw away the water, and repeat the operation six or seven times. The gold, with care, will remain at the bottom. A bowl with five or six pounds' weight of stuff may be washed in a few minutes, and this method will be quite as productive as the "cradle," in which, by the testimony of all parties, half the gold is wasted. The sediment may be treated with quicksilver as before, if required, and the superfluous quicksilver may be wrung out through a piece of wash-leather, leaving the gold amalgam behind. We shall by-and-by show how to recover the quicksilver.

We are here supposing the absence of mechanical contrivances, many of which are more ingenious than useful, and that the Australian miner has chiefly to depend on his wits and his arms. To such, the following easy method, well known in South America, is worth more than the "cradle," and is attended with none of its inconveniences. Make a wooden gutter, the longer the better; very slightly incline it, so as to allow the water to run off; put your soil at upper end; and if the gutter is long enough, all the soil may be washed away, leaving the gold at the top, or at most, not half way down. The running water thrown on will carry off all the light soil, and the stones may be picked out by hand. The gutter, to be efficacious, should be wide, and pretty deep, and if long enough, there would be no fear of losing any gold. Such a contrivance where a party is working, would, in point of producing, beat a dozen cradles.

A shallow tub or pail makes a first-rate washing machine. The manner of using it is this:—Place the tub in the water, an inch or two under the surface, then stir up the sediment,—the running stream will carry all the light soil away, and by-and-by you will have a respectable tubfull of gold; the stones may be picked out as before, and the remainder either separated by hand or with quicksilver.

The cradle, as used in California, is a rude affair, and acts upon some of the preceding principles. It is eight feet long, and stands on rockers, whence its name; at its head it has a coarse wire grating, the bottom is

rounded with small cleets across. Four men are requisite to work it. One carries the soil and empties it on the sieve, another digs it from the gold bed, the third rocks the cradle, and the fourth supplies the water. The gutter we have spoken of is a better, though not so compact a contrivance. In the cradles, the sieve or grating keeps out the stones, the water clears away the earthy matter, and the gravel gradually finds its way out at the foot of the machine, leaving the gold and sand above the upper cleets. This is taken out, dried in the sun, and the sand blown away. The above description is from a despatch by Colonel Mason, given by Professor Ansted. It would be useless to give any further description of gold-washing contrivances. All are on one or more of the above principles, and he must have little ingenuity who could not both make and use them.

The tools necessary are just as simple, and consist of a crow-bar, a pick, and a shovel, to which may be added a blacksmith's striking hammer for breaking any rock supposed to contain gold. Other implements are unnecessary. The crowbar is indispensable. If quartz has to be crushed or ground in any quantities, mills are necessary, but these we shall not stay to describe, as they involve a great expense, and are the work of the engineer. The above improvisatory methods are sufficient for all ordinary purposes.

Quicksilver is recovered from the amalgam by distillation, leaving the pure gold behind. Quicksilver machines may be purchased in London, and would be found highly serviceable where the emigrant can afford to go out well equipped for his work. But let him avoid encumbering himself with ingenious mining *impedimenta*. When on the gold fields he will soon be rich enough to indulge in scientific whims, and by that time, indeed even now, he may purchase them in the colony.

Much gold is now lost in Australia by the cradling method; but by the methods we have described, not a particle need be lost, and the digger may work independently of others; whereas, in cradling, he must be in partnership. Mr. Rudder, now in New South Wales, but formerly in California, gives the following variation on the cradle, but that of Colonel Mason, above described, is in our opinion preferable:—"The cradle," says Mr. Rudder, "should be four feet long, twenty inches wide, and have a slide of two feet under the hopper which leads to the grating—not mere wire netting, as the use of this is to keep stones out of the machine." This is a complication of affairs, and gives two feet less in the inclined plane than Colonel Mason's, which almost any one is carpenter enough to make for himself. The inclination of the cradle should be half an inch to a foot.

Thus much for the theory of gold washing. We will now inform the intending emigrant how it is applied in the Australian gold fields. From what has been previously stated, he will readily comprehend the distinction between river diggings and dry diggings, the latter being on slopes where the water has ceased to operate, having left the gold at some remote period. At the dry diggings, being away from the stream, the gold is usually found near the surface. We will suppose a party "prospecting." or in search of new diggings. They provide themselves with crowbar, pickaxe, shovel, and prospecting pan, the latter being the high-sounding term for a large, round, flat-bottomed tin dish. As soon as they perceive the geological indications of gold, they fill their pan and carry it to the stream, carefully washing the contents out, all but the gold, which sinks to the bottom. By filling the pan and washing it out two or three times, a few minutes will decide whether the soil contains gold, and whether it exists in paying quantity. If the spot promise to be remunerative, to work goes the cradle, which has been sufficiently described. This is vigorously rocked, water being poured on so as thoroughly to separate the mud, clay, and earth from the stones, which are picked out by hand, a glance being sufficient to determine whether they are pebbles or nuggets of gold. These, however, rarely occur in clayey soil. The cradle is again filled, and so on till the accumulation of mud at the ledges is sufficient for examination. It is then scraped out and examined, the larger gold being carefully picked out, and the remainder

washed clean; though much gold is lost for want of quicksilver to take up the fine particles scarcely visible to the eye.

River diggings are, however, the most valuable, and it is in these that "nuggets" are chiefly found. Here more than a superficial examination is necessary, as gold will not in all probability be found at the surface, the holes and crevices in the original rock bed of the stream containing the greatest prizes. The soil, too, may be gravel, in which case, as we have previously explained, when considering the geological character of the gold fields, the precious metal will have percolated through the upper stratum, and will have descended to the bed of the stream below, where it must be sought for. The shovel and the prospecting pan will soon decide this. If after removing the upper stratum they reach a tenacious clay, a blue colour being considered the best, they will know that this has never been disintegrated by the current, but on the contrary, consolidated, and on the surface of the clay bed they may be pretty certain of finding gold in a comparatively thin layer. Should the prospecting party determine on working a spot presenting the true indications, they dig a trench, and by means of "back troughs" divert the course of the stream. The bed of the stream being thus laid dry, and all the large pebbles and gravel removed, the clay stratum is exposed and washed as before.

It will be well to watch for any old bed of the stream, now dry, but one over which the water has formerly flowed. Such dry beds are not unfrequently most-productive. It is easy to tell where, in these old beds, an eddy has formerly existed, and there should the search be made. They will here dig till they reach the original bed of the stream, when the gravel will have to be removed as before, and the clay bed will have to be arrived at. The holes thus dug are sometimes of considerable depth, and if a good yield is obtained from the crevices of rock or pockets, as they are termed, the bed is followed and tunnelling commences under the adjoining banks. Sometimes hundreds of pounds' worth are obtained in a single day by parties who possess even the little mining experience which we have endeavoured to impart, whilst others less instructed will be digging away at a hole a few yards distant, without a chance of obtaining a single particle of gold.

(From the *Observer*, March 23, 1854.)

IRON AND ANTHRACITE.

Colombo, 21st March, 1854.

To the Editors, "Ceylon Observer."

SIR.—Observing in your issue of the 20th inst. a remark that Dr. Gygax is "totally silent as to the existence of anthracite in Ceylon, though he is said to have discovered it," I take the liberty of informing you that the finest specimen of anthracite in the British Museum is labelled as being from "*Saffragam, Ceylon.*" It presents a flat surface of nine to twelve inches, and is beautifully iridescent like some of the best descriptions of coal. It attracted my attention in 1846, on occasion of a visit I then paid to the Museum, and I made many anxious enquiries about it from the Curator of the department, who was, however, unable to give me any further information than that it had been in Great Britain some years previous in the collection of a Col. Greville, and that there could be no doubt of its genuineness. On this I went to my friend, the late William Tindall, who was like myself struck with the importance of the matter, and after another visit to the Museum and joint inspection of the specimen, we put ourselves in communication with the late Minister for the time being, and were by him referred to the Commissioners of Land and Emigration, for full information as to the terms on which the anthracite mines, if discoverable, could be worked.

We accordingly requested an interview, and after about a week's delay, this was accorded, and we were received by a gentleman whose name I forget, but who represented himself as the organ of the said Commissioners. Our enquiry had been "on what terms would H. M. Government dispose of the right of working anthracite, if we could find the same in remunerative quantity?" The answer was explicit though any thing but satisfactory. We were

informed that the Commissioners would not sanction the sale in the right of working minerals *on any terms*, but that they would lease any mines we might discover for a limited number of years, on payment of a royalty. Of course we pointed out that it was perfectly preposterous to expect that any capitalist would sink money in machinery, roads, the exportation of miners, &c., if he were merely to have a brief lease of the mines on which his money was expended, but our words were wasted. Her Majesty's Commissioners had decided the point without even seeing us, and there was an end of the matter.

I need hardly say that this intimation was in itself sufficient to annihilate all wish on our part to have any thing to do with mining in Ceylon. Before leaving, however, we felt bound to press the point "what would be the extent of the royalty demanded"? a question which our official friend eluded like an eel, till being at length brought into a corner, he graciously intimated that he did not think it would exceed forty per cent? On this, Mr. Tindall told him he should think no more of the matter, and the interview terminated.

It was just one of the many instances constantly occurring in which excessive greed defeats its own object. Any person who new the late Mr. William Tindall, knows that he was not a man to do things by halves. Had he been met in a fair spirit, he would have sent out a mineralogist to Ceylon, he would have purchased the anthracite mines, if discoverable, and possibly at this day, Ceylon would have had not only smelting furnaces but a railway.

Let us hope that our present Government is wiser in such matters than its predecessors, and that instead of thus throwing difficulties in the way of discovery and enterprise, they will afford every reasonable facility.

Your obedient servant,

JOHN ARMITAGE.

MINERAL RESOURCES OF CEYLON.

Our notice of anthracite in our last has brought us a letter from Mr. J. Armitage, which is worthy of attention, as shewing how private enterprise, on which the progress of countries and peoples depends, can be stifled by the influence of mere red tapism. A change has come over the spirit of English Statesmen since then, however. Sir John Pakington conceded, and the Duke of Newcastle confirmed, to the Australian Colonists, the right to make the best they could of their mineral wealth; and altogether we believe the spirit in England now is so different, that any official acting as the agent of the Land Commissioners did in 1846 would get him to relieve Government of his obstructive presence. We believe the Home Government would support the local one in offering a thousand pounds reward to any one who would discover a workable anthracite mine in the neighbourhood of the "millions of tons of iron in Saffragam." Such a discovery would be of incalculable importance at present. We should soon have a railway from Colombo to Galle via the iron and coal works of Saffragam, conveying coal to the steamers and iron sleepers for the railways of India. Such a consummation would be of far more importance to Ceylon than even a successful issue to the search for gold—an issue which, we are fast coming to the conclusion, we have little right to expect. Gold dust we have, but there is as yet no established discovery of nuggets. The bit of gold forwarded to Mr. Power as mentioned in our last, was from Dambedeniya, in the olden times the capital of the Muaya division, the seat of Royalty and of a Mint. On page 243 of Davy's work will be found an engraving represeniing the fignres on the Dambadinia Rhatra (gold) and the Dambadinia chally, (copper.) Justice Starke, in a paper on Numismatics, in the transactions of the Asiatic Society, states that in Davy's Work the reverse is turned upside down, and that the characters which Davy described as resembling hieroglyphics, really represented the monkey chief Hanuman, with Visnu on the obverse. Now looking at the hoarding propensities of our Kandian brethren and at Dr. Ellery's report

that the bit of gold was entirely without alloy, we strongly suspect that this was just an old piece of Rana's or Demon's money knocked up into a convenient shape. The search for gold will bring such things forth without any intention to deceive; but the specimen from Newera Ellia is far more suspicious. Mr. Sterling has declared it to be alloyed with copper in a proportion which is never seen in *nature*, but which exactly tallies with that of the jeweller's gold in Ceylon. Dr. Kelaart, however, appears to have found a few grains of gold on the Plain, and, notwithstanding the rather off-hand decision of his friend Hopkins, the Geological Doctor is not without hopes that the diggers may "fall into" a pocket of gold. If they do, we suppose, they will say as the Irishman did when he tumbled into a hole full of water of which his friend *meant* to have told him "Never mind, I have found it." Our notice of the red quartz at Mr. Anstruther's property of Hyndford has brought us the information that some time ago a sailor who had made his way thither asked leave to search for gold, and was referred to the Government authorities, after which nothing further was heard of him. Another edition of the anthracite story perhaps.—With reference to the controversy respecting the Ophir of Solomon and the ancient Taprobane, we append a couple of extracts which we find in Mr. Hardy's *Friend*:—

CEYLON, THE OPHIR OF THE SCRIPTURES.

It is probable that the precious metals were obtained by Solomon from the island of Taprobane, so often mentioned by the ancients, which lay but a short distance from the Red Sea and the Arabian Gulf, from which the fleets of Solomon and Hiram sailed. Taprobane is the island of Ceylon. Some writers tell us that it was called by the ancients Simunde, which readily becomes, in their hands, Sinmande or Sumoende; and finally Sumatra. A celebrated geographer indeed mentions Taprobane under this name; but it is an error of the manuscript, and the reading should be Palæ Simunde. It was thus known to the ancients, and was afterwards called Salcs, and then Ceylon, from which island Solomon undoubtedly obtained his great riches. The reader may consult on this subject Bochart, who has produced twenty-one particulars, in which the Ceylon of the moderns and Taprobanes of the ancients. It abounds in precious stones and ivory. The only objection to receiving Ceylon as the Ophir of Solomon, is, that it required three years for the fleets of that prince to complete their voyage to Ophir, whereas Ceylon lies at a short distance from the Red Sea. According to Strabo, the ancients, in sailing to this island from the main land, discovered it on the seventh day, but did not reach it until the twentieth.

However this may be, the length of the voyage was occasioned by the miserable equipment of their fleets, which consisted in part of vessels of papyrus. Isaiah observes that the Egyptians despatched "vessels of papyrus" to the maritime cities, to announce that their god Osiris was again found. How could such vessels withstand the violence of the waves or winds to which they would be exposed in a voyage to Ceylon? By papyrus vessels are meant those whose sails were made of papyrus, which was ill-adapted to such a purpose. Strabo accounts for the length of the voyage to Taprobane, by saying that ships were either bad sailors or had poor sails. The Jews in the time of Solomon were even less experienced in navigation than the Egyptians; and they probably did not venture out of sight of land, but protracted the voyage by coasting along Arabia and India to Ceylon.

Some have thought that the coast of Malabar is the Ophir of the scriptures, because it was called by the ancients Souppara, or as Josephus writes it, Sopheir. We shall not pretend to say whether Malabar or Ceylon is the Ophir of Solomon. These countries are so near each other, that a fleet which visited one of them would naturally touch at the other. Perhaps individuals might have passed over from Malabar to Ceylon, though they did not form any settlement on that island. Benjamin of Tudela relates that he saw a deep abyss in this island, which his interpreter, though a learned man, worshipped as a god. The inhabitants made their children pass through

a fire, which was kept always burning, in honour of this deity, who was called Alhauta. They derived this custom more probably from the Canaanites and Tyrians, than from the Jews.

Benjamin assures us that in his travels through India, he met with many of his countrymen, the Jews. He found one hundred in Ceylon, which he describes as producing white pepper and ginger.—*Basmage's History of the Jews.*

Anglo-Saxon Map.

In an Anglo-Saxon map of the 10th century, Ceylon, under the name of Taprobana, is placed as the most eastern part of the world, in size a little larger than Ireland. It is said to have ten cities, and two fruit-seasons in the year.

Arabia, Africa, Continental India, Malacca (where the natives still call the gold mines *Ophirs*), and even Peru have been set up as rivals to Ceylon in the competition, but probably many of our readers will join Mrs. Fletcher (Miss Jewsberry) in exclaiming :—

Ceylon ! Ceylon ! 'tis nought to me
How thou wert known or named of old,
As Ophir, or Taprobane,
By Hebrew king, or Grecian bold :—

To me thy spicy-wooded vales,
Thy dusky sons, and jewels bright,
But image forth the far-famed tales—
But seem a new Arabian night.

And when engirdled figures crave,
Heed to thy bosom's dazzling store—
I see Aladdin in his cave ;
I follow Sindbad on the shore.

Dr. Gygax's report of 11th January, 1849, is not forthcoming, but a gentleman who took notes of its prominent contents has favoured us with the following Memo :—"Gold.—Traces of it in the iron pyrites of Gettyhedra, which might be worked for its alum, and thus the gold would pay."

Latest Gold Intelligence.

On the 21st Mr. MacCartney reported from Bradley's Diggings that the quantity of Gold found on the previous day was "very much greater" than in any corresponding period ; "and one of the specimens nearly as large as half a grain of Rice." On the 22nd (yesterday) it was apprehended that if the rains continued operations would have to be sus ended.

We have seen the nugget forwarded by Mr. Talbot. It is about the size of a small grain of rice—its weight about 2 grains. It was given to that gentleman by a person who is in the habit of visiting Ratnapura in search of precious stones, and who in 1850 received it from one Kirihamy of Kuruwitte Korle. The latter said he had found it at a place called Madol Deniya in Weraloowa, about a mile from Ratnapura on the Colombo Road, a canal running up to from the place the river. The person to whom it was handed kept it as a curiosity, shewed it to one or two persons, and produced it to the Agent in reference to the discovery of Gold. He produced two other specimens dug by himself at Delwella, but without being aware whether they contained Gold or not. The Nugget found by Kirihamy did not adhere to any other stone when handed to the present owner, but it had been washed with precious stones in a sieve.

The surface of the soil where the stones are found he describes as black, as on marshy lands, with blue clay or "Kirremettya" [Kaolin] underneath.

The Two "Toms."

It may be as well to correct the impression, should it anywhere exist, that the "Tom" used by the diggers is identical with or has any relationship to the gentleman who has received the special appointment of Gold Commissioner. The Tom used by the diggers is a *timber* one, which of

course renders the supposition the more ridiculous. There is nothing *wooden*, whatever there may be of good metal, in the composition of the Gold Commissioner.

(From the *Ceylon Times.*)

THE MAHA OYA DIGGINGS.

Having been to the scene of the operations of the Seamen late of the *Martin Luther* in the bed of this river in their search for Gold, we now are able to form a better opinion of the matter derived from a careful personal inspection extending over two entire days in a place which both for heat and desolation exactly resembles the lower ravines of the hills which lead the Nerbudda and Taptee Rivers of Guzerat to the plains, or of the gorges and vallies which take the rains off the Ghauts, of the Deccan, all like the Maha Oya affording the same characteristics for gold, both as to geological formation and general appearance.

As to the question of gold in the Maha Oya, there is no doubt whatever on the point, for not only did we see others procure it, but with the aid of a tin pan and a spade which we took from Colombo, we washed some 12 or 15 pans of clay or gravel quartz dug out of the river bed from amongst some large quartz boulders. In four or five of these pans, after careful washing, we found amongst the black sand left after the washing off of the earth-clay, and quartz, from one to two most minute specks of gold of a more vivid yellow tint, which through a lens evidently by their abraded surfaces showed the effects of long travel from the original matrix whence they were washed to the lower parts of the river by the heavy floods of ages.

Independently of the product of our own personal exertions we saw the results of trails by other gentlemen who were also successful in their search, nay one visitor Mr. Anthony Worms of Pusilava, took a few handsful to the gravel and with Mr. Jones of the same place, carefully washed it, and found what may be called the only nugget which has hitherto been taken from the Maha Oya. This specimen was about the size of a small canary seed, flat on one side, the other being rounded. On Saturday, Bradley and his chums set to work about 8 o'clock in the morning, and with the aid of about 12 or 14 coolies washed from 4 to 500 buckets of earth, and on clearing the trough under the Tom at about 5 p. m. the *residuum* showed about 150 to 190 specks of Gold, the value of which might be 10 shillings. The opinion formed not only by us, but by almost every Englishman present (about 30 in number) during the two days we were there was, that although Gold *was present*, it would not pay for the trouble and outlay necessary for the prosecution of the search ; but as a mineralogical search where the outlay of a *few pounds* would produce a *few farthings worth of Gold* in order to establish the fact of its presence : the experiment was worth the outlay. Gold there is, but he would be a bold man who either forsook his common avocations in life for a prospect of obtaining a livelihood by gold seeking, or dared the deadly climate of that desolate spot for any time beyond a few days. Fever is already amongst the seven men, three of whom including, the head (Bradley) have been already laid up. The heat in the bed of the river closely shut in by forest to the very edge of the sands, is of that intensity which none but those who have visited the place can have the remotest idea ; —a hot breeze setting in after noon which plays amongst the trees, heating every object even under cover adds additional charms to the lovely locality, whilst here and there are continually seen little whiriwinds of hot air, spinning round and round taking up in their gyrations columns of dust and dead leaves.

We will now give a slight description of the place and its locality.

On arriving at Ambepusse you can easily obtain coolies both as guider and baggage carriers ; leaving the Resthouse at the stables, you turn short to your left and crossing a range of dry paddy fields, you come to a path leading through about 2½ miles of low jungle abounding in quartz rocks and boulders, with here and there spaces which have been cleared by the

natives for planting Koorakan grain. Throughout this distance there are two or three native huts, whose inhabitants (if they had any) were not visible. At the end of these 2½ miles you descend a bank about 20 feet declivity to the bed of the Maha Oya, at this season presenting a flat surface of sand and small pools of water here and there, the breadth of the expanse being from 150 to 350 feet; having at the present time about sufficient running water to turn a few water mills. Wading through these pools for about a mile, you reach what are called the "diggings." On the left Bank—looking *upwards* to the source of the river—you perceive a clearing—lately burnt off—of about 12 or 13 acres bought by Mr. John Selby—on which is erected the Talipot covered house occupied by Mr. Power the "Gold Commissioner,"—close to this nearer to the river bed is a talipot shed put up by the Rest-house-keeper of Ambepusse, at which weary gold seekers may procure refreshments at—for the place really moderate rates. On the opposite side of the river are a half a dozen huts, put up by the Police about 30 in number and by the Diggers themselves.

The scene of operations is in the bed of the river. In the centre of the almost dry bed, is a small rocky island which the natives say was cut off the main land by a heavy flood in 1838;—the hole, out of which the seamen and others wash the deposit is at the upper portion of the island which divides the stream into two parts during the monsoon—at present both channels are nearly dry. The depth of the deposit is from two to three feet to the solid bed rock and "the Tom" which we have already described is within about 20 feet of the hole from which we should think up to Saturday about from 7 to 10 tons of "stuff" have been washed from first to last by the Diggers and visitors. The extent of the deposit is about 300 feet long by 70 broad, and its removal to the "Tom" would, if the diggers worked 8 hours a day, occupy some five or six months to remove. We had not time to travel the river downwards from the excavation to any extent; but for the mile above it we saw no alluvial products, nothing but a bare expanse of sand with here and there a few ridges and slabs of quartz rock.

Above the "Tom" some 200 feet, a dam has been constructed by a gang of labourers at the charge of Government, but as the water could not—except at a heavy expense be raised to within 17 inches of the "Tom," it has been allowed to remain in *statu quo*, and a forcing and lifting pump (which our readers will see, we recommended in our last issue long before we saw the locality) indented for on the Commissariat. This, with the aid of two or three coolies, will supply the washing machine with a constant stream of water.

With regard to the nuggets said to have been handed to the "Gold Commissioner," we may remark that we saw them both, one was evidently a piece of "manufactured gold" cut off a little strip of the same metal with a sharp chisel; the other certainly bore the impress of being pure, it had originally been about the size of a common pea, but it had had two portions of it cut off leaving the fragment flattened on both sides. The other nugget alluded to by the *Observer* as having been sent for from about 8 miles distance by Mr. Power, did not arrive but we saw an influential native, the Basnaike Nillame of Katugampola, a place about 8 gows or 32 miles to the Westward of the Maha Oya; an old respectable Chief, who told us that there was no gold in this district, nor had he ever heard of any being found, and other natives concurred in saying that they feared there was no hope of any but small bits being found. Both Mr. MacCartney and Mr. Power are doing their best to elicit the best information as to the existence of Gold as likely to afford a remuneration for the expense of search, but we do not think up to the present time either they or any who have enquired into the matter have any sanguine hope that any digging in the Maha Oya or the surrounding districts will afford any but the most infinitessimal quantities of Gold.

Mr. Power having a "roving Commission" and properly so—has set off with Bradley for a search higher up the river either at Mahwanelle, or

Gordon's Bridge towards the hills. Mr. John Selby also accompanied him, and we may expect the result of Mr. Power's observations in the course of two or three days.

The sum total of our observations is this—that Gold *is* in certain localities in the Island—that it is both the duty and interest of Government, to ascertain additional facts by issuing orders to every Government Agent in the interior to expend a sum of money in the exploration of the different stream beds and vallies of the Island. That the result of the researches may end in nothing is probable, but as small portions of Gold have been found there is no reason to ignor the possibility of finding gold in localities nearer the hill ranges in quantities which may induce extended search which may possibly be a source of profit to speculators. But so far as we have yet seen if the prospectors find no more than has hitherto been seen the whole thing will prove a "delusion."

Much amusement has been produced by the issue of licenses by Government, who have yet to "catch their hare" before preparing it for the spit; they should rather encourage every attempt to find out the hidden treasures of the soil of the Island and it would then be time enough to "put the screw on" when they had ascertained the fact of the existence of gold enough to pay the expense of a 10 shilling license. Just now not a man would purchase one. We shall look with anxiety for the results of the exploration of Mr. Power which will we believe settle the question of the existence of gold in large quantities in the Colony. At present the matter is a perfect problem on the solution of which depends most important changes. It is we believe an ascertained fact that Mr. Talbot the Government Agent of the Southern Province has forwarded to the Colonial Secretary a small fragment or nugget of gold found at Ratnapura, it is about the size of a seed of the sweet pea, and from what we hear appears to be a *bona fide* production of the soil and which has never been in the Goldsmith's crucible. We must conclude our remarks to-day by referring our readers to extracts on the Gold Question taken from the columns of the *Examiner* and *Observer*.

The whole question is still as far off solution as ever, and our opinions as to the improbability of finding gold to pay the outlay required in collecting it remain as unchanged as ever.

P. S.—3 p. m. Since writing we have just heard from the "Diggings" in date yesterday. Other visitors have made their appearance there and one writes us that he does not think much of the appearance of things at this "fashionable watering place"—The diggers still find gold but "very little of it."

One parting remark we may make, which is that as a large body of Police are at the Maha Oya, and a Detachment of Rifles are under orders for the same locality, it would be just as well if Government allowed them additional subsistence money. There is nothing to be obtained in the desolate hole itself, and prices of all kinds of provisions are exorbitant. At the same time we may add that the services of a Medical man will also be necessary, for we have no doubt fifty per cent of those sent there will be prostrate in a fortnight hence.

Through the kindness of the Colonial Secretary we are enabled to announce the following :—

"Mr. Macartney has been left in charge, Mr. T. Power having left the spot for further exploration, everything was going on quietly and the party at work were continuing to find gold in small quantities ;—no applications had been made for licenses."

(From the Ceylon *Examiner*.)

THE GOLD DISCOVERY.

In answer to an application for the loan of Mr. Hopkins's pamphlet Dr. Kelaart has sent us the following letter which will be read with interest at the present moment. He informs us that "large pieces of gold" are reputed

"to have been found in the Galle district." We shall not indeed be surprised to hear of gold being found in considerable quantities in various parts of Ceylon. Its formations are those of auriferous districts. Only the other day a friend told us that in an elephant shooting excursion he came upon quartz rocks which he felt sure abounded in gold. It is a well known fact that the quartz composing the Ural mountains contains gold in sufficient quantities to pay for being pounded. A personal inspection by Mr. Hopkins of the geological features of the Island would have been peculiarly valuable just now—and we shall be glad to hear the result of Dr. Kelaart's upland trip.

My Dear Sir,—As I intend to examine Bradley's diggings when an opportunity offers, and report upon its geological characters in connection with my friend Mr. Hopkins' views on the gold mines of other countries, I therefore beg to be excused sending you the pamphlet for the present, especially as the publication of any portion of it at this moment without a geological chart of the Ceylon diggings will only disappoint your readers, or discourage the gold seekers in Ceylon. Let them go on as they have begun and success may still attend their labours.

I can, however, inform you that on Mr. Hopkins being told that a few grains of gold were found some years ago in Newera Ellia, he bade me not be too sanguine as to finding the precious metal in any large quantities in Ceylon; for although, gold is diffused throughout nearly all the primitive rocks in the world, the characters of the Ceylon primitive rocks are not such as hold out promises of very productive fields of gold, but that there is every reason to believe that gold is to be found in Ceylon in the same "small" proportion as in some of the primitive rocks of Southern India. And, it is quite possible that Bradley and his companions may fall into some localities where there are "pockets" of gold, the accumulation of ages, the debris of worn down granitic rocks.

It is a pity that Government should have stopped (at this early period), digging in other parts of the Island. I have every reason to believe that hardworking men with a few practical lessons from Messrs. Bradley & Co., will succeed in finding gold in the same small quantities as at Ambepusse in various parts of the Island. The valleys of Dimboola, and Saffragam Kotmalie, &c., must be as auriferous as the banks of the Maha Oya.

I shall be agreeably surprised to hear that nuggets of gold are found in this Island. The geological character of Ceylon (as known to me) do not hold out any such rich golden prospects. However, it is only by examination of the course of the Maha Oya and its rocky bed that the geologist, or the practical mineralogist, will be able to speak positively on such a valuable subject as this.

As Mr. Hopkins was for some weeks in Galle, he would have gone up at my suggestion to examine the geology of the mountainous districts of the Island, but that he did not think it worth the expense of travelling, as the same species of rocks as cap the heights of Pedrotellagalla and other mountains are found, a few feet above the sea's level, in and about Point de Galle. The "Felspathic" granite, in which gold in fine grain is so abundantly found in Australia, is the kind of rock on which the fort and town of Galle are built. The clays also which abound in the neighbourhood of Galle, even below the sea's level. Micose and talcose schists, border the beds of rivers and canals. So that an eminent mining engineer like Mr. Hopkins has now sufficient data to appreciate the golden dreams of Ceylon. By the last mail he was informed of "Bradley's diggings," and therefore, as he was the geologist consulted by Government on the discovery of gold in Victoria he will doubtless be referred to by the Colonial Office for information regarding Ceylon. It was his particular wish that I should keep him informed in all matters connected with future Ceylon diggings, which he thought would soon be heard of from the number of Australian diggers finding their way to Ceylon. I can only regret that I cannot immediately make an inspection of the diggings to find out if there is any new feature in the geology of the district hitherto

unknown to the geologist, and I think I may point out to Bradley and his friends some of the likely sites of gold-bearing rocks "in situ," from the additional knowledge I have acquired from Mr. Hopkins since my last visit to the Highlands of Ceylon.—Believe me, yours truly,

Point de Galle, 17th March, 1854. E. F. KELAART.

P. S.—For the information of some of your readers I may as well inform you that Mr. Evan Hopkins, is the geologist and engineer of the Victoria Gold Company and was for 9 or 10 years the director of the largest Peruvian gold and silver mines. He is also the author of the work on the Electro Polar, or magnetic formation of primitive rocks, which upsets the doctrine of igneous formation. The mining journal in reviewing Mr. Hopkins' system of geology observes that "owing to its practical application to mining, and the satisfactory manner in which it accounts for all phenomena connected with terrestrial physics it is becoming an established system with practical men. The interest has been considerably enhanced of late, owing to the recent discoveries made by the indefatigable Dr. Farraday, corroborating in a remarkable degree, Mr. Hopkins' views, as explained in his works."

Another reviewer says "that the igneous theory, the doctrine of central fire, has for some time been slowly yielding to other views. All the phenomena attributed to fire may be produced (according to Mr. Hopkins' system) by electro-magnetic currents. It is difficult to imagine the existence of fires unsupplied with the oxygen of the atmosphere."

To this I may add that since I have applied Mr. Hopkins' views to the geological structure of the primitive rocks of Ceylon I have less faith in the doctrine of the igneous formation.

THE (GOLD?) DIGGINGS.

(From the *Ceylon Times*, March 24.)

We have letters from this place, both of the 21st and 22nd instant, which fully confirm our former opinions that gold-finding to pay will prove an utter failure. On the 21st we find that two of the finest specimens were found much finer than that dug by Mr. Anthony Worms a few days since, but the result was utterly unremunerative.

On the 22nd not a soul in the shape of an Englishman made his appearance; heavy rains had fallen and the men had ceased to work, and if the rain continues, there is no doubt they must shut up "spades and picks" and again plough the "sounding main" in place of digging the bed of the Maha Oya;—indeed we have heard that two of them have already returned and shipped themselves on board the *Lady Sandys*, and a week hence we shall expect to hear of the total abandonment of the whole thing.

The result of the exploration of the 21st was 6 spangles of gold as large as a small canary seed, three of them being a little larger, so that probably the whole find of Bradley and his fellows, from the 6th of the month to the present time, has not amounted to 15 shillings.

Heavy rains with violent thunder had commenced, and the next accounts will bring intelligence of the sweeping away of the dam if it has not already gone. The Police we hear had killed a small crocodile, in their hut which showed fight, never once atempting to run from the blows inflicted. We hear that the whole are sadly disgusted and we may expect a week hence to hear that "Bradley's diggings" have resolved into their primeval solitude, tenanted only by the alligator of the river and the wood-pecker of the forests of this miserable and deadly hole. We speak feelingly, for we are compelled to curtail our remarks in to-day's issue from an attack of fever, the result of too much exposure whilst prospecting for gold in a midday sun in the delectable locality. So far as we hear, the best thing is to order all the Police there to forsake the place at once;—the farce of keeping 30 or 40 men with officers, to look after a *challie's* worth of gold is too palpable an absurdity to be persisted in for a day longer.

We repeat that there is not gold enough to be found to pay for the sustenance of a mosquito, and the curtain should be allowed to descend on the whole farce at once.

Latest from the Gold Explorers.

We are told that Mr. Power, Dr. Ellery and the Seaman Bradley who went to the Maha Oya Diggings, and left that place on the 19th instant in prosecution of further search to the North-East of the river, have made further discoveries of auriferous earth in the bed of one of the tributaries of that River, called the "Hingool Oya," giving a name to that Valley through which was to have run a portion of the Railway to Kandy, which, under the auspices of Lord Torrington would ere this time have been in full work giving a most ample return for outlay. This river runs to the South-West under a wooden erection at the foot of the ascent of the Kaduganava Pass, called Gordon's Bridge across the Kandy road between the 58th and 59th mile stones.

Tracing the Maha Oya upwards at the village of Attapittya, at about 40 miles above the original station, they again found auriferous earth; the specks very small, but existing in every pan of earth washed. The above report is of so early a date as Tuesday last, but the delay in its receipt, was owing to its having been sent to Kandy en route to Colombo.

We have had no further report from Newera Ellia, but from indirect sources we hear that the search has been unproductive of Gold.

Altogether we much fear the outgoing Mail of to-morrow will take but a "Flemish account" of the far-famed Gold discoveries in Ceylon.

(From the *Colombo Observer*, March 25, 1854.)

Postscript.

Mr. MacCartney reports in a letter of yesterday's date that the rains had put a stop to the digging operations, but that Bradley and his party still retained their good opinion of Ceylon as a gold country. Bradley has returned to Ambepusse from his "prospecting" tour with Mr. Power, suffering from fever. Temporary assistance had been asked from Government, but no reward is looked for until profitable Gold diggings are discovered.

(From the *Colombo Observer*, March 27, 1854.)

MR. HOPKINS' PAMPHLET.

We have seen a copy of the pamphlet so mysteriously alluded to by Dr. Kelaart and are by no means inclined to cry out "Eureka!" The writer has a theory which he embodied in a big book, and the object of the smaller one published at Melbourne seems to be chiefly to draw attention to this theory and to support it. The theory is a very pretty one with doubtless much of truth in it, and it appears to have been found practically valuable. It is no new discovery that crystallization obeys certain fixed geometrical laws, nor is the idea novel that magnetism is the principal agent at work in giving to minerals their distinctive shapes. Mr. Hopkins merely goes a little further than others in a certain direction; explaining by reference to his own theory what others have attributed to igneous agencies of which he pretends to see as little in the great mountain ranges which intersect the globe as in the scattered deposits of metals and minerals found within their bosoms or lying at their bases. "Terrestrial Magnetism, the polarity of matter and the meridional structure of the crystalline rocks" are the catch words of his geological faith. His main principle is that "Nothing can destroy the active and reproductive principles of the mineral kingdom. In the deep recesses of the crystalline film the subtle power of polarity is present, constantly permeating beneath the scene of vegetable and animal life, and a never-ending process is going on, giving form to mineral matter in all its variety, from the formation of a crystal to the aggregation of crystals which constitute a Continent."

He must be a man after Mr. Simms' own heart. He dwells with horror on the variations of the needle which may put the boundaries of a Survey out "*in a few years*," and he agrees with our Surveyor General that great base lines and trigonometry should be at the foundation of all Surveys.

But neither those who dig for grains of gold or to produce "Golden Grain" can wait to study trigonometry or to start from base lines. We sympathize with Mr. Hopkins however in his preference for water, and there is no denying the decomposing power which he attributes to felspar. We see it daily converting our granitic gneiss into useful cabook and good soil, while even the glass-like quartz, affected by the same subtle agency, is forced to yield up the wealth of gems or metals which its maternal bosom encloses. Felspathic rocks are the richest in minerals and the rocks of Ceylon are highly felspathic—that is a fact indisputable: and if we have not large deposits of gold now, they will *grow* with the lapse of ages and for the use of future generations. Posterity has certainly done nothing for us, and yet we can rejoice at its good prospects. Here we have still stronger proofs that the root and twig-like gold of the Mahawanso was a substantial verity, for Mr. Hopkins is decidedly of opinion that the roots of trees and even grasses exercise a decided influence on gold in the process of formation. The roots of large trees should therefore be searched in the neighbourhood of the Maha Oya and other Diggings. One of the tales that delighted the childhood of most of us was the discovery of the silver mines of Peru by the accident of an Indian grasping and uprooting a shrub to save himself from falling, the discoverer enriching himself before he revealed the secret. Mr. Hopkins has seen gold formed in the shapes of ferns or corals, and deposited in old mines on leaves of trees. A long account of the supposed process is given, tending to this principle, that "carbonate of soda is a most important substance to sprinkle in a poor soil to liberate the elements of the crystalline rocks to feed the roots of plants: the required nourishment is thus absorbed from the soil, and the metals and other ingredients rejected by the roots are left behind like indigestible substances." "The roots of trees take up the potash and leave the gold behind." "In the same manner [?] the ferruginous rocks forming red caps on hills by the decomposition of the iron, are favourable for the liberation and development of the gold, contained in auriferous slates. Hence the red hills are favourable localities to the gold digger." We are thankful to learn that gold is never mineralized—that though often found mechanically connected with iron pyrites it is always metallic. It is improper therefore to say, as we have all been saying, "gold ores or minerals." Mr. Hopkins who has had much mining experience states that auriferous pyrites in the Andes containing from 5 dwts. to 3 ozs. ℔ ton are pounded and washed. From the decomposing mass several *crops* of gold are ultimately obtained. In alluvial deposits, such as those in the Maha Oya and on its banks, "the favourable productive parts are necessarily found at the points presenting the greatest resistance to the streams, such as ledges of rocks, boulders, hollows in the bed and bends in the channel." These principles seem to have been observed in the choice of Bradley's diggings. The following principle, however, if correct seems to point out what the nature of our Ceylon diggings must be:—"the gold produced from felspathic granite, in the absence of slate, is of fine grain." Just so: we have no slate but plenty of felspathic gneiss—our gold is fine. Were it found abundantly and in large proportion per ton of earth, this would not matter: but this is the point at issue and it is of great importance that it should be decided. If the original band of Diggers are not all placed *hors de combat* by the malarious climate of the Maha Oya, the interval between the March rains and those of the regular S. W. Monsoon would be the best possible time for an extended and thorough search.

The Gold Question.

Our notice of Mr. Craig's discoveries in Saffragam has brought us the following letter which corrects some misapprehensions on our part. We think it a great pity however that Mr. Craig should leave the Island with any degree of uncertainty hanging over the alleged discovery of copper. Some of the richest and most valuable ores are found of "the true copper colour," altho' green is the general hue.

Galle, March 24th, 1854.

Dear Sirs,—I have just perused your issue of the 20th Inst.—and on the subject of Gold in which you mention my name, allow me to inform you that *the substance* I discovered while tracing a road in Saffragam was not shewn to Dr. Lamprey—and it needed no examination; it contained as you say copper—with the usual copper colour.

The substance given to Dr. Lamprey by me, was found near the road from Avisawelle to Karoen Ella (on the banks of the latter) and with regard to which you state "a further examination, &c., is said to have led to the detection of Gold in Mr. Craig's specimen." Now allow me to say that I gave you this information from having heard from good authority that Dr. Lamprey had forwarded or was about to forward a paper to the Asiatic Society stating that he had discovered Gold in a specimen that had been found somewhere near "Ruanwella." Now as Karoen Ella, or the place where the substance was found that I gave Dr. Lamprey, is within 2 miles of Ruanwella, I considered that it might possibly be *the* specimen I furnished him with and such I believe was the information I gave you—and as it was only on supposition I beg an insertion of this in your next.—I remain, dear sirs, yours faithfully, ROBT. CRAIG.

We regret to learn that Mr. MacCartney, the Superintendent of Police has returned to Colombo suffering severely from fever. It is said that Major Skinner has been ordered from Badulla to form a road from Ambepusse to the diggings.

Mr. Simms, with a Staff of Surveyors, has also been ordered to the locality, so that we hope the Public will soon be in possession of a map affording some further information than that recently given to the world where the "Property of J. Selby Esq.," occupies so conspicuous a place.

The purport of Dr. Ellery's report we believe to be that from near Ambepusse to the diggings the Maha Oya flows slowly over water-worn gneiss with occasional masses of smooth quartz. The diggings are situated where the river takes a sudden bend from a South Westerly to a North Westerly course. Here there is a large "diluvial" deposit of smooth gneiss, quartz boulders, sand and gravel cemented together by a reddish clay. The gold was distributed throughout the mass, but was most abundant in the deeper parts and in the rock crevices. The drift seemed to have come from a distance. The gold is either in scales or small rounded masses, much water-worn. On proceeding 40 miles towards the source of the stream Gold was found in the tributary Hingool Oya, near Gordon's Bridge between the 58th and 59th mile stones on the Kandy road. The Geological formation seems much the same throughout—large detached masses of gneiss with quartz pebbles. Dr. Ellery describes it as resembling in its general and particular features many of the gold yielding tracts of Australia, and he is of opinion that by the aid of proper machinery and deep digging the results might be remunerative. On the Maha Oya itself gold was found at Attapetiya, 2½ miles from Gordon's Bridge, at Deyanella, 6 miles farther up and at Nartakanda coffee estate 3 more miles towards the source. Mr. Power corroborates Dr. Ellery's report and supports his opinion that deep digging and careful washing would yield profitable results. He reposes confidence in Bradley, who with his Californian and Australian experience declared that gold abounded in the region traversed by the prospecting party.

(From the *Examiner.*)

The following is the result of personal remark and information forwarded by others.

At *Bradley's Diggings.*—Yattalgoddo on the Maha Oya, the dam after being erected was found useless—the distance required (270 feet) being too much for the hose. A forcing and driving pump has been sent for, and it is expected that it will enable the diggers to work continuously. That

party has been greatly reduced during the past few days, Bradley and another having been absent prospecting with the Gold Commissioner—and another having been sent away sick to Colombo under charge of a comrade. As has been before remarked the gold found appeared generally to increase in size according to the depth dug and this was further confirmed by the finding on Saturday last of a piece of rather more than 2½ grs. in weight. This was taken out by a gentleman who having noticed the similarity of the rocks at *Bradley's Diggings* and in the Mahavilliganga and Kotmalie Oya both of which streams run though his properties intends to prospect forthwith. Having noticed in our former report that a native had found Gold. and sold part of it to Mr. Jayatellike Mudaliyar of Kornegalle, we were glad to see a piece of the same gold, which was brought from the village by orders of the Commissioner and having been tested by Dr. Ellery of Kandy was pronounced to be *pure gold.* The rocks about Yattalgodde are generally of gneies with large quantities of mica and layers or strata of broken quartz both pink and white. But a little higher up the river this is completely altered. There you find the gneiss rock abounding in mica and garnet in layers or strata, with well defined quartz veins running through the whole mass in every possible direction ; sometimes *at right anyles to the strata,* everywhere in short where a fissure has enabled it to penetrate. Proceeding higher up the river small tributaries are found draining the adjacent hills and supplying part of the auriferous deposit of the Maha Oya one of the principal of these is the *Hingôl Oya*—it rises in the Kaduganava mountains and draining all that part of the country falls into the Maha Oya just below Hingolla—a village to which it gives its name. The Kandy road crosses this stream at Gordon's Bridge and as it was of importance to ascertain whether the tributaries supplied their share—the diggers prospected about 20 yards above Gordon's Bridge and the result was satisfactory—Gold was found in the same minute "specks" as found at first at Yattalgodde. Proceeding higher up and touching the main stream again at Fort King washing was recommenced and with the same result. Gold was again found. Above Fort King for some two miles the traveller passes over a vein of granitic gneiss with little or no quartz in it ; but at Deyenwelle he again finds it. The experiment was repeated there and with success. Pushing onwards the river was searched at Nartakanda Estate in Dolosbage (having now passed the boundary of Four Korles) immediately blow the magnificent waterfall and again the presence of gold was detected—and thus in all the five places reached, 4 in the Maha Oya itself ; the highest spot at a distance of not less than from 50 to 60 miles from the lowest, and one in a tributary stream, gold was discovered—thus proving that over a great extent of surface the auriferous deposit has taken place. It should be borne in mind that from the shortness of time before the mail would leave, their experiments were necessarily confined to surface-washing and in no instance was a greater depth than from 18 to 20 inches reached ; the tools a crowbar and a spade with a common tin basin to wash with. At Nartakanda Estate it was reported that a piece of gold attached to quartz had been found in Upper Dolosbage of the size of a walnut—but our informant, who had handled, had not *tested* it though he said he believed it gold ; the precious metal has also we have heard been found at Matelle by a caangany in the service of one of the largest estate proprietors in the Island—that Gentleman at once went to the Diggings to learn the '*modus operandi.*' And doubtless he is digging now. Returning via Ambepussc we heard that the yield was about 2 dwts. daily—this with only 3 diggers (2 being as before stated with the Commissioner and 2 gone to Colombo) and with neither bore nor pump, and only surface digging for they have not yet reached a depth of five feet below the surface.

P.S.—Since writing the above we have heard taat the quantity of gold increases rapidly as the digging gets deeper, and that three pieces were found in one day larger than the 2½ gr. piece mentioned above.

(From the *Observer*, June 19, 1854.)

GOLD AGAIN.

We have been informed that Bradley and his fellows who have been employed by Mr. John Selby in searching for gold, have at length succeeded in finding the precious metal on a private property at Newera Ellia, in nuggets, at a depth of 2½ feet from the surface. Of course we do not ask our readers to believe more than they like of this rumour.

(From the *Observer*, June 29, 1854.)

GOLD.

The Mountain, 22nd June, 1854.

MESSRS. EDITORS,—The sensation caused by the *so-called* gold discovery at Ambepusse has hardly terminated before we are again startled with the intelligence of nuggets being found at Newera Ellia, and as you surmised the news is to say the least premature, for from personal enquiry I find the total yield to date is about 40 or 50 specks being the proceeds of a *number* of days' work, and as it is almost necessary to use a microscope to make them perceptible, you may be assured that it is a matter of difficulty to ascertain their probable value; but if we *can* rely upon the opinion entertained by the diggers themselves, the days for coffee growing are numbered, as they anticipated finding a mine of wealth in the Newera Ellia plains, and this does not seem improbable if we bear in mind the fact, that these men are devoting their time and labour to an enterprise of which there are great misgivings; but if Government are desirous to develope the mineral resources of the country, they could not do better than employ Bradley in charge of a lot of men and persevere in the work they have commenced, and in the meantime your readers may rest satisfied that to the date of this letter there has not been six pence worth of gold found at Newera Ellia, although it must be admitted that gold *may* be found there in galore; those who want an insight into the mysteries will be well repaid by a visit to the diggings.—Yours obedient,

ALPHA.

(From the *Observer*, July 6, 1854.)

GOLD AT NUWARA ELIYA.

As calculated to interest our readers we take from the *Examiner* portion of an article and from the *Times* part of a letter on the gold discovery at Newera Ellia. It seems to be the old story over again—gold, but not in nuggets or in quantity to pay. Happily however the prospecting now goes on in a region not necessarily fatal to Europeans.

(From the *Examiner*.)

By Friday afternoon at 3½ o'clock the shaft had reached a depth of some 36 to 38 feet. The soil penetrated was first, thick black and peaty-looking—next coarse yellow-clay with sand and stones mixed with it, then very fine pipeclay—afterwards coarse loose gravel and large stones—with a larger pipeclay below—and lastly fine gravel and decomposed rock. The stones found in this layer had evidently been exposed to the action of some rapid current, all being rounded from the smallest to the largest. Although it was not considered that that the shaft was deep enough, it was determined as our commissioner had to leave the following morning, to try a few pans of soil—and about 4 cwts. were washed. The result was highly satisfactory; a sufficient proportion of gold being produced to pay the working expenses. The gold is very fine and small, and there is no doubt that with the rude appliances used much must have escaped. No *nugget* nor anything in the nature of a *nugget* was found; nor could it have been expected by any one who saw the nature of the soil from which the 4 cwts. were taken, only the smallest and lightest portions of so heavy a metal as gold being retained in it. On the request to wash some of it, the diggers at first objected that it would be useless, and it was only done to satisfy those who could not wait for the deeper digging. We shall receive a report in a day or two of the result

of deeper sinking which will be immediately published. Gold has been now found in this (Newera Ellia) District over an immense extent. It has been found as you enter the plain on Mr. Selby the Queen's Advocate's land, on the side of the hill at the back of Sir A. Buller's, on the low swamp in front of Mr. O'Connor's—at Messrs. Baker's saw mills, on the high land close by, on the Moonstone plains where the diggers are now working, and lastly Mr. Baker having learned how to *prospect* from the diggers, went some three miles lower down on the Badulla road and in every place that he tried found Gold. How much farther it may extend cannot of course at present be known but here is an extent of 6½ miles over which it is known to be spread, and that too so thickly that even an unskilled washer can find it in every pan of surface soil. Mr. Baker has we believe ordered a quantity of "Toms" and "Cradles" to be prepared so satisfied is he of the auriferous wealth of the district, and others also are following in the same track, indeed before we left Mr. O'Conner had a "Cradle" at work in which the 4 cwts. of soil we mentioned formerly were washed.

(From the *Times.)*

Newera Ellia, July 1st 1854.

TO THE EDITOR OF THE "CEYLON TIMES."

DEAR SIR,—I send you to-day a sample of the Nuwara Eliya gold the result of one pan-full of surface earth that was washed to-day. Bradley and party were hard at work last week sinking a deep hole or shaft, so soon as the bed or primitive rock has been come to the intention is to drift or tunnel due North and South. The place where the present diggings are going on is the *Moon Stone Plains* at a distance of about ½ a mile from Newera Ellia plains, it is exceedingly strange to see such a medley of things and creatures on this hitherto deserted spot *cooking, eating, drinking, smoking, laughing,* and hard work is the order of the day you can here see the roaming *Irishman,* the cautious Scotchman and the knowing little Englishman all watching for the first big nugget so as to if possible get the reward if any from Government. Bradley's expectations are sanguine and indeed the s ame feelings have seemed to inspire all at Newera Ellia. Toms, cradles, pans, &c. are all at work ding-dung, several toms and cradles are to be at work next week, so that matters are beginning to assume a business-like shape. Combined with the gold washing there is a prevailing anxiety after gems one person has picked up a sapphire worth £20. I would wish to impress on your friends in the planting line that there is no fear of Malabar coolies working for one week at Newera Ellia at such work as gold digging really is. I have had 10 years' experience of what the Malabar and Singhalese character is with regard to enterprise and I can with every degree of confidence assure you that I have never met with a Malabar or Singhalese who had that amount of pluck, energy and hardyhood which a man requires to work at gold digging and washing more particularly at a temperature like Newera Ellia ; just fancy a Malabar man from morning to night up to his *as coccygis* in water, working as hard as it would be possible for him to do, so fatiguing was the work I noticed going on last week there were only two men, Bradley and a little Irishman, who did not lag ; so that it is not every European that can even stand it, and the man who does must have his heart in the right place ; planters need not therefore apprehend any injury from scarcity of labour, should the Newera Ellia diggings become ever so lucrative an occupation. We will say but little as to what will be the end of this infant gold field ; one thing is quite certain, that at the present moment a good washer when the weather is as fine as it is now, can from the proportion of gold found in every pan of earth earn from 7s. 6d. to 10s. a day, and I am told that a part of Bradley's gang are to see what can be done in that way next week, so as to keep them in funds.

(From the *Observer*, July 8, 1854.)

The question of gold at Newera Ellia (the Mountain Sanatarium of Ceylon) is again being discussed in the papers. In our Supplement will be

found a letter which accompanied a respectable specimen of the dust sent to our address by a dweller on the Plains; while from our local contemporaries we have taken extracts on the same subject. It seems strange that neither there nor at Ratnapura did we ever hear of gold in connection with deposits of precious stones until European research has proved their simultaneous existence. Did nuggets of any size exist it is difficult to conceive how the gem diggers missed them—although, to be sure, they never affected deep digging. The present operations it is satisfactory to contemplate, are carried on in a climate exceedingly congenial to European life and health, if we except a tendency to dysentery in those who work long in the wet, from which Australia and California equally suffer.

(From the *Colombo Observer*, July 10, 1854.)

NEWERA ELLIA DIGGINGS.

To the Editors, Ceylon Observer,

GENTLEMEN,—I beg to hand you enclosed a specimen of our Newera Ellia gold, the proceeds of one pan of suface earth; there is scarcely a pan of earth that is washed on any of the feats that has not the same quantity of gold in it, but at a depth of 40 feet the gold becomes a degree larger, and Bradley and his party think there is no doubt but that nuggets will be found on the primitive or bed rock—they have now a fine shaft sunk of about 40 feet, at the bottom of which there are little streams of water working out of the sides; by careful observation the precious metal can be seen washing out from the land, and from this indication the men at work say there is sure to be a treasure close at hand; the next part of the work will be to drift or tunnel, and in doing so, the North and South directions are the intended course.

With the glaring facts now before us of gold being found *even* in *small quantities*, is it not a reasonable question to ask what do Government intend to do? I most humbly think it is time that his Excellency the Governor had put all doubt at rest by expressing his intention to encourage or discourage the enterprise, as also to say what would be the reward given if gold was found in paying quantities at Newera Ellia or its vicinity. By a statement of the Government intentions, a capitalist would be able to judge if it would be worth his while to compete with Bradley for the reward which is now *only supposed* will be given. There is another question, if answered by the *Observer*, would be of infinite benefit to all parties holding property in this island. Would the discovery of gold in large or paying quantities do good or harm to the island generally? *You* may perhaps think any answer to my question just now would be premature, and I would much like to see some discussion on that grand point; however anticipating as I do from reasons I will hereafter mention, that the good to be derived from such a valuable metal being found in quantity would be of universal benefit to all classes of Her Majesty's subjects. I cannot but look on with surprise at the little that has has been done by the Government of this island towards investigating completely this pending matter; the men now engaged have not the means left them to go on exploring, and what individual having means within his power would invest it on a speculation, when in doubt as to the intentions of Government? Let any man read his title-deed and the answer is there, *all minerals and gems go to the Crown.* It is supposed that the discovery of gold in this island would affect so much the prospects of its present staple article "Coffee," that the Government fear to interfere, in case there should be a cry out by the proprietors of estates. Surely there are no men amongst that intelligent body who can for one moment conceive the idea that finding gold in large quantities would harm their interest. If any I can from a week's experience of hard digging assure them that there are *not* 10 *out of every thousand* coolies in Ceylon who would stand by the work for one week, indeed it requires a European of no ordinary spirit and endurance to remain at work from day to day for the term of seven days. I think in this opinion the *Examiner's*

Commissioner will join. The attraction that gold would cause to coolies being the only reason why proprietors of estates can fear for, being considered as groundless by all who have visited the Newera Ellia diggings, we will now consider the good which would occur to planters by the full development of the hidden treasure.—No. 1, A Rail-road.—Cheap transport for coffee to Colombo, and to the *railroad terminus*; low freights to England and France, as our imports must increase so must shipping; cheap money as exchange must fall; cheap agency at Colombo, as then merchants will have more competition, and lastly, export duties of all kinds would fall, as our island revenue would increase to so great a degree by imports and *land licences*, that Government could then afford to do so. As to superintendents becoming diggers, which I doubt, many of them could stick at it, I would say to proprietors that there is as *good fish* in the sea as ever was *caught*, more good men could be brought out from home; but to come to one point in particular, may I ask would it not benefit Her Most Gracious Majesty's Exchequer to find gold in large quantities! How therefore can any man suppose that the Government of Ceylon would fear the clamour of one particular class! No more than would a bailiff on any gentleman's estate in England disregard his master's interest in the seeking for a gravel pit which would give profit to the man that gave him wages, in order to consider what harm or injury the discovery of the pit *might* do to some individuals with whom he was on terms of regard and friendship. No. No. Sir G. Anderson is too good a servant to his Queen not to come forward with assistance, when it is brought to his notice in a proper manner that such assistance is necessary for the full and complete development of the subject. For this end the inhabitants of Newera Ellia purpose to send a graceful and respectful Petition to His Excellency the Governor; and, Sirs, your good names have been mentioned as being about the best to represent one interest here, beyond that to which you are ever ready to lend a hand of the people. A small fund has now been established by some persons at Newera Ellia to help the *Maha Oya* hero with his grub; but he wants more than grub, and we all want an outlet for the slow stream of water that runs out of Newera Ellia Plains, before the flat digging can be gone on with.

I am, Gentlemen, faithfully yours,

SPECTATOR.

Newera Ellia, July 4th, 1854.

(From the *Colombo Observer*, August 11, 1854.)

DISCOVERY OF GOLD IN NUGGETS.

The Gold Seekers are persevering in their search at N. Ellia, and deep digging seems really to have produced nuggets.

(From the *Examiner*, August 5.)

The Moon Plains Diggings, Newera Ellia.

We have abstained from noticing from time to time as accounts reached us, the progress of these works as there was no new feature to report—the gold having continued in dust or small grains—now, however, that *nuggets* have been found, we at once put our readers in possession of the fact. Yesterday reports reached Colombo, that on the previous day the bed rock having been reached, five or six nuggets were found in the washing, besides a larger proportion of gold dust than had previously been obtained.

At present the depth reached is but small (about 40 feet), and it was at about the same distance below the surface that the digging ranged in Victoria for a considerable period—now, however, we hear of all the richest diggings in Australia being at a depth of 150, 160, and even 180 feet—and we trust similar results will be obtained here.

GOLD IN SAFFRAGAM.

(From the *Ceylon Observer*, November 2, 1868.)

We have so frequently been deceived in regard to discoveries of gold in Ceylon, that we are inclined to receive all fresh alarms with caution. But certainly the evidence seems to be in favour of real nuggets having been found by a "gemming" party in Saffragam. The pieces which have reached the Cutchery are from $\frac{1}{8}$ to $\frac{3}{8}$ of an inch in length of various breadths, flattened, and much like specimens from New Zealand. A mass of the weight of half a sovereign tested as true gold has been melted from the nuggets, and is declared to be 22 carats—better than sovereign gold. The friend who sends us this intelligence anticipates "Railway to Ratnapoora and to Adam's Peak!" Who can say? If not for gold yet for iron. If there are plenty of such nuggets as have reached Colombo, Ceylon will pass through a new phase, and the steam engine which is on its way out to be used for "gemming" will be the precursor of multitudes. The gem region is just the region where gold might be looked for, and we shall not be surprised if this is a real and great discovery.

GEMS AND MINERALS.

(*From Mr. Saunders' Administration Report on the Sabaragamuwa District for* 1869.)

There is little to say under this head, but to repeat my opinion, and the same has been held by almost every Assistant Agent for the last 20 years, that a very fair revenue might be derived by licensing diggers on waste lands and in streams.—I beg to invite attention to my letter No. 361 of the 5th September 1867, and the connected papers on the subject. About £3,000 worth of gems are said to have been found on private lands during the year, including two very fine cats'-eye priced at about £200 each, but no other stones of remarkable value.

No active steps have been taken in the matter of the "gold" discovery, though the Government Agent forwarded a few of the grains, or rather nuggets, for the inspection of Mr. Brough Smyth, the Minister of Mines at Victoria, and that gentleman reported that he had carefully examined them, and was of opinion that they had not travelled far, and that a careful search in the neighbourhood would probably be repaid.

Owing to the sudden fall in the price of plumbago, the digging for this mineral has not been so briskly carried on as I had anticipated and hoped. I believe the quality of the plumbago found in this district is very good, but the cost of transport renders it less remunerative to dig here than nearer Colombo or other ports of shipment.

GOLD IN THE SABARAGAMUWA DISTRICT.

(*Reports from the Assistant Agent, Mr. Saunders, to the Government.*)

Ratnapura, December 1868.

Sir,—I have the honor to report to you that gold has been discovered in Sabaragamuwa, under circumstances which, in my opinion, justify my asking the attention of Government to the matter.

You are aware, Sir, that there are some old gem pits and some untried land (sold to private parties by Government) on the north bank of the Katugas Ella, which flows at the bottom of the garden attached to the Assistant Agent's house. Some of these pits have lately been and are still worked by the jailer at Ratnapura and others. The attention of the diggers or washers has frequently been attracted to pieces of bright metal amongst the dark black sand which they dug up, but for some time this was supposed to be mica, or, as the natives called it diya-rattrang (water gold), curiosity, however, prompted the jailer to collect some of it, wash and smelt it—he brought samples to me for inspection, and I thought it worth while to forward them to you. I wish them now deemed to be submitted with this letter.

On your informing me that the gold when tested was found to be good

quality, it became my duty to look into the matter more closely, and for this purpose I made the acquaintance of Mr. William Murray (a gentleman owning coffee estates in Rakwana), who for many years worked in the gold fields at Ballarat and Bendigo, &c., who has thereby a thorough practical knowledge of the proper means to be adopted in searching, digging, and washing for gold. I saw Mr. Murray on Monday, but his business would not allow of his leaving the estate at once, and he was (like myself) somewhat doubtful as to the importance of the discovery, but he very kindly said he would come to Ratnapura when leisure permitted him, and yesterday he ran in for a few hours. We went to the pits, and the watched manner in which the black heavy sand was turned up—some baskets full were washed, dried and sorted—and Mr. Murray expressed himself completely astonished at the result. On viewing the samples which after a few rough washings were in a white bowl, he exclaimed "ah! that's the real stuff, and no mistake if a sample like that was found in a claim at the 'Ovens,' the whole of Ballarat would be prospecting the flat." Mr. Murray could hardly conceal his excitement as he conducted his operations, and it is quite clear to me that he at least considers the discovery to be very important. I felt some delicacy in questioning him, or if I may use the expression, in "pumping" him on the subject, as I was unable to tell him what steps the Government would take with regard to the rights of private parties in the event of gold being found in workable quantities, nor was it in my power to tender him, or promise him any remuneration for a detailed report. He was however most obliging in the matter, and expressed his willingness to assist Government in any way in his power. He declares the prospect to be most encouraging, and the discovery to be well worthy of the most thorough investigation. He thinks that these washings are probably from a false bottom, which would account for the smallness of the grain, and that the real bottom is not yet touched. He recommends that one or two shafts should be sunk to try and find a lead—a few "washing boards" (which he described worked at the stream), and the neighbourhood fairly prospected. Until the views of the Government in the event of the discovery becoming important are made known to me, I can take no further steps. I can neither stimulate nor control private searchings, nor can I even reply to enquiries made upon the subject. Two or three points I consider require to be at once decided. Firstly, will the Government put forward any claims to gold found in lands sold at high prices expressly as "gemming lands?" Secondly, what claim will Government assert to gold found in ordinary private lands? Thirdly, what inducements or facilities will Government offer to persons to search for gold on Crown lands and in river beds?

The question of "claims" when gold is found, rules and regulations for working, export duty, &c., &c., may of course be left for consideration, until we are assured that the discovery is complete.

If I may be allowed to make a suggestion, I would ask to be authorized to request Mr. Murray to give the Government a brief report of his visit, with his opinion on the prospects of success and the immediate steps that should be taken to develope the discovery. If he advises measures similar to those already stated, I would recommend that he and the Director of Public Works be associated with me in carrying out the preliminary experiments with authority to spend say £100, and then report the result to Government. I mention the Director of Public Works as a thoroughly practical man, who would probably know where to get and how to apply the skilled labour required to the best advantage. If this officer cannot be spared, the Surveyor General would perhaps be able to undertake it. Should His Honor the Officer Administering the Government, or you desire further information from me, before taking any steps in the matter, I think it would be well that I should at once wait upon you in Colombo. I may mention that it is my present intention to apply for a month's leave of absence, the 26th instant, to visit Colombo, but my application will be restricted to a few days in December, if the exigencies of the public service demand my attendance at Ratnapura. —I have, &c., (Signed) F. R. SAUNDERS, Assistant Govt. Agent.

No, 598—B. Ratnapura Kachcheri, December 16, 1868.

Sir,—I have the honor to forward to you copy of a letter addressed to me by Mr. Home stating the terms on which he his prepared to prosecute a search with the view of ascertaining if gold in large quantities exists in Ratnapura.

I think the terms worthy of the attention of Government, and with slight modifications I venture to recommend a favourable consideration of them.

It will be seen that Mr. Home trusts entirely to the liberality of Government as soon as the discovery of a gold reef is made, the Government is to be informed, and Mr. Home is to be rewarded according to the value of his discovery. This is precisely the manner in which the Government of New South Wales treated with Mr. Hargreaves, the discoverer of gold at Bathurst, when he announced that he had found gold. But in the present instance, no valuable discovery has as yet been made.

There are indications of gold in the neighbourhood, in fact nearly one ounce of gold dust has already been collected, but careful and steady search is necessary to ascertain beyond a doubt whether or not gold in quantity exists.

I proposed to you in my letter that Government should undertake this preliminary search, but if a private individual comes forward and in hopes of the reward undertakes the task and risk, I think it would be more advantageous to employ him.

I would suggest that Mr. Home's terms be amended thus:—

That the Government do give to him (and I think to him and his servant only so long as they steadily work) the right to dig and follow up the present lead, he paying a liberal assessment for all damage done and rendering and account of all gold found, and that, as soon as gold in quantity be found, the Government do take over the discovery, paying Mr. Home a liberal reward according to the value of the discovery when ascertained.

It must be evident to any one that no private individual could undertake to trace a lead or vein of gold to its source through numerous private lands without the aid of Government, and when Mr. Home states that he will either pay the full value of the land through which he may require to pass or merely the damage done by him in digging up the land (at the option of the land owner), I think his proposal is very liberal. It must be borne in mind that supposing private owners of land to have any claim to the gold beneath the surface, Mr. Home's proposal does not affect them, for the instant the gold is found, the Government takes over the discovery, and may allow the land proprietor to pay only a royalty of 5 per cent, whilst on Crown land finders pay 10 per cent. These I believe are the rates of royalty charged in New South Wales, and it is evidently the interest of every proprietor to assist in a search which may lead to the gold being found in or near his land.

I need hardly say that in recommending these proposals I assume that the Government considers the discovery of gold a thing to be desired and encouraged. Certain settlers will, of course be found, from fear that the industrial pursuits of the country may be interfered with, to oppose it, but experience has shewn that the Governor-General of New South Wales was right when he stated that it would have been as futile to attempt to stay gold digging as to stop the tide, and that on no just or sound principle of Government could it be justified.

The evil to be apprehended is uncertainty, and a rush of persons to a field which may turn out valueless. Disappointment would induce recklessness, disorder, and distress, but if it was known that a search was being made, and that its results would be duly proclaimed, public excitement would be kept down and ordinary business be uninterrupted. It seems to me to be our duty to encourage and promote any search that will at once and for ever settle the disputed question, and if it should be that gold in quantity is really found, we ought to be, and I trust we should be found thankfully prepared to take advantage of the wealth which Providence opened up to us. —I have &c., (Signed) F. R. Saunders, Assistant Government Agent.

To the Govt. Agent, Western Province.

Ratnapura, December 11, 1868.

Sir,—I have just returned from visiting the Ratnapura gold field, where the sample was taken from, which I saw at the Kachcheri, the gold I found at Ratnapura appeared the same as what had been found previous to my going there. I believe from the experience I have had in gold mining elsewhere, that gold could be got at Ratnapura in paying quantities, if systematically worked by an experienced miner. I would therefore propose to Government the following :—

That I alone may be allowed to search within a radius of 2 miles from the point where the first tracings of gold were discovered for a period of two years, and request that Government take all such private lands as the gold can be traced on to, as for public purposes the necessary assessment being defrayed by me, or that the Government do secure to me the right of digging along and through private lands, until I arrived at the quartz reef, paying compensation for any damage, and in the event of my sticking a payable quartz reef, my reward to be averaged according to its value, I retaining the right of working the same at the rate of royalty or duty claimed by the Government of Victoria.—I have, &c. (Signed) John W. Home.

F. Saunders, Esq., Assistant Government Agent, Ratnapura.

No. 16. Government Agent's Office, Colombo, January 13, 1869.

Sir,—With reference to your letter No.——of the 16th ultimo, I have the honor to annex for your information Copy of one No. 12, dated the 9th instant, from the Colonial Secretary with its annexure. I have, &c.,

The Assistant Agent, Ratnapura. (Signed) F. R. Saunders.

Copies.

No. 12. Colonial Secretary's Office, Colombo, January 9, 1869.

Sir,—I have referred to the Queen's Advocate your letter of the 18th ultimo, No. 818, with its enclosure from your Assistant at Ratnapura, relative to a proposal made by Mr. Home to prosecute a search with the view of ascertaining if gold in large quantities exist in Ratnapura.

I am now directed to transmit to you copy of a communication received from the Queen's Advocate in reply to the reference from which you will observe that he is of opinion that the Ordinance No. 2 of 1863 does not empower the Government to take up private lands for the purpose of ascertaining the existence of gold therein.

I am to add that it would be impossible to concede to Mr. Home the exclusive privilege of searching within a radius of two miles, and he must trust to the liberality of the Government to reward him according to the value of his discovery, if gold should be found by him to exist in remunerating quantities. I have, &c., (Signed) J. Swan, for Colonial Secretary.

The Government Agent, Colombo.

No. 381. Colombo 31st December 1886.

Sir,—With reference to your letter No. 589 of the 24th inst., I have the honor to state that the Ordinance No. 2 of 1863, which enables the Government to enable the Crown to take possession of private lands for public uses, does not, in my opinion, authorise the taking of private lands for the purpose of ascertaining the existence of gold therein.

That Ordinance provides for the taking of private land for an ascertained public purpose, such taking being shown to be "necessary for the public advantage." It is not consistent either with the letter or spirit of that enactment that the Government should deprive a subject of his land for the speculative purpose of ascertaining whether or not gold can be found in it.

I have, &c., (Signed) R. F. Morgan.

GOLD IN INDIA AND AUSTRALIA.

(From the *Madras Mail*, March 28, 1881.)

The Government of India in analysing Mr. Brough Smyth's famous report remarked: "If we omit the altogether exceptional sample from Wright's Level which gave 24½ oz. per ton, and the picked specimens from the same workings which gave 25½ oz. per ton, we get 88 samples, yielding an average of 1 oz. 8 dwts. 22 grs. of gold per ton." That was the result of Mr. Brough Smyth's explorations in the Wynaad over a period of eighteen months. Let us compare these figures with actual mining results in Australia. The actual yield from quartz-mines in Queensland was about equal to Mr. Brough Smyth's average specimens in the Wynaad. The average yield in New South Wales for the same year was 1 oz. 5 dwts. 7 grains per ton. There is no lack of rich "specimens" in Australia as in the Wynaad, but experience has taught the Australian miners not to attach too much importance to specimens. The average yield of a mine over a period of time, is a far more certain indication of the value of land in the neighbourhood for mining purposes. With the above figures before us, we may well ask ourselves what there is to justify the high prices that have been paid for mining lands in Southern India? This is a matter, however, that chiefly concerns speculators in England; if they are satisfied it is not for Indian landholders to complain.

The reports before us contain some useful hints for the managers of the companies that are commencing operations in our midst. The importance of having improved machinery is strongly insisted on. Though the gold-saving appliances in Queensland are acknowledged to be "the most modern and approved obtainable in Australia," yet, we are told, it has been demonstrated by practical assay that as yet, "only about 50 per cent. of the gold contained in quartz is obtainable by our appliances. In some few reefs, where the mundic is largely impregnated with sulphides, especially zinc and lead, and nothing like 50 per cent. of the gold can be obtained, even when the reverberating furnace is used." Indeed the importance of the proper treatment of tailings, and matter which has passed through the quartz-crushing mills, is becoming universally recognised. The Queensland report avers that one-seventh of the yield of gold in one district had come from the "pyrites works," the owners of which are supposed to have made large profits. It is worthy of remark that the total value of quartz-crushing machinery in Queensland, is put down at £270,000 only, a small sum in comparison with the capital that has already been raised for mining in India. But with this machinery, the yield of quartz-gold in the colony in 1879 was about 190,000 ozs., worth at £3-10s. per oz., about £650,000. The yield from alluvial mines (chiefly worked by Chinese) in the same year, was 98,815 ozs. The total yield of gold for the year was 288,556 ozs., valued at £1,009,946, the number of miners being 3,191 Europeans, and 5,621 Chinese; and the average earnings of each individual miner was £114. For the year 1878, the earnings were as low as £74.

From the same official documents. we gather the interesting fact, that the total Australian gold supply from 1851 to 1878 was £240,000,000. And yet gold-mining flags in Australia, though any quantity of auriferous land may be had for £1 an acre. "The want of means to carry on prospecting operations for the discovery of the new gold-fields, and the gradual exhaustion of those easily-worked deposits of our known gold-fields, have been the main causes of the decrease in the number of our gold-miners, and until new fields be opened, or the necessary capital and skill for working the deeper or more difficult deposits of our older gold-fields be forthcoming an increase of our gold-yield can scarcely be expected." Such is the opinion of Mr. Harrie Wood, the experienced Under Secretary for Mines at Sydney. It is some consolation to reflect that gold-mining in India will not languish for want of capital.

GOLD IN CEYLON.

(From the *Ceylon Observer*, April 7, 1881.)

The following is Sir Samuel Baker's reference to the first discovery of gold in Ceylon :—

It has hitherto been the opinion of most writers on Ceylon that the precious metals do not exist in the island ; and Dr. Davy in his work makes an unqualified assertion to that effect. But from the discoveries recently made, I am of opinion that it exists in *very large* quantities in the mountainous districts of the island. It is amusing to see the positive assertions of a clever man upset by a few uneducated sailors. A few men of the latter class, who had been at the gold-diggings both in California and Australia, happened to engage in a ship bound for Colombo. Upon arrival, they obtained leave from the captain for a stroll on shore, and they took the road towards Kandy, and when about half-way, it struck them, from the appearance of the rocks in the uneven bed of a river, called the Maha Oya, 'that gold must exist in its sands.' They had no geological reason for this opinion ; but the river happened to be very like those in California, in which they had been accustomed to find gold. They accordingly set to work with a tin pan to wash the sand, and to the astonishment of everyone in Ceylon, and to the utter confusion of Dr. Davy's opinions, they actually *discovered gold!* The quantity was small ; but the men were very sanguine of success, and were making their preparations for working on a more extensive scale, when they were all prostrated by jungle fever ; a guardian-spirit of the gold at Ambepussé, which will ever effectually protect it from Europeans.

They all returned to Colombo, and, when convalescent, they proceeded to Nuwara Eliya, naturally concluding that the gold which existed in dust in the rivers below must be washed down from the richer stores of the mountains.

Their first discovery of gold at Nuwara Eliya was on the 14th of June, 1854, on the second day of their search in that locality. This was found in the 'Vale of Rubies.' I had advised them to make their first search in that spot for this reason ; that, as the precious stones had there settled in the largest numbers, from their superior gravity, it was natural to conclude that, if gold should exist, it would, from its gravity, be somewhere below the precious stones, or in their vicinity.

From the facility with which it has been discovered, it is impossible to form an opinion as to the quantity or the extent to which it will eventually be developed. It is equally impossible to predict the future discoveries which may be made of other minerals. It is well known that quicksilver was found at Cotta, six miles from Colombo, in the year 1797. It was in small quantities, and was neglected by the Government, and no extended search was prosecuted. The present search for gold may bring to light mineral resources of Ceylon which have hitherto lain hidden.

The minerals proved to exist up to the present time are gold, quicksilver, plumbago, and iron. The two latter are of the finest quality, and in immense abundance. The rocks of Ceylon are primitive, consisting of granite, gneiss, and quartz. Of these the two latter predominate. Dolomite also exists in large quantities up to an elevation of 5,000 feet, but not beyond this height.

CAUSES OF SUCCESS AND FAILURE IN MODERN GOLD MINING.

(From the *Ceylon Observer*, April 18, 1881.)

The *Journal of the Society of Arts* for 21st January contains a paper read by Mr. A. G. Lock on the above subject. In opening Mr. Lock stated that

The "Stock Exchange Year Book" for 1880, reveals the fact that £2,240,449 of English share capital was invested in so-called "gold-mining" enterprises at the end of 1879. An analysis of this sum shows it to be composed of—

£871,658	which has never paid a dividend.
362,041	which has paid none for some years past.
110,000	which is paying about 3 per cent.
896,750	which is paying 10-50 per cent.
£2,240,449	

In other words, more than half this large amount is utterly unremunerative.

To this fact, Mr. Lock said, was no doubt due the suspicion with which the enterprise has come to be regarded, whereas, if properly conducted, none was safer or more profitable. The causes that determine the success on failure of an undertaking were stated to be as follows :—

1. The soundness of the constitution of the undertaking.

2. The presence of gold in the property, and the existence of the ordinary facilities for mining operations.

3. The knowledge of how to extract the gold in the property, and the provision of suitable appliances for the purpose.

Mr. Lock mentioned the several conditions under which gold occurs, viz :—

(1.) In the form of scattered grains and nuggets, in alluvial deposits, having been liberated by natural causes from its original matrix; (.2) In the form of grains and leaves, in mineral veins (principally quartz), still enveloped in its matrix, but not associated with any other metals, and technically known as "free" gold; (3.) In the form of grains, imbedded in and most intimately associated with (not chemically combined with) various other metallic compounds, chiefly sulphides and arsenides, and commonly known by the comprehensive term "pyrites," disseminated throughout veins of quartz or other mineral.

The first class Mr. Lock passed over, as there is less difficulty and making expense in treating it. The process of crushing and stamping was then described, the best forms of stampers and proper order of their drop being detailed. Mr. Lock said :—

I would here direct attention to a class of stamps recently brought into notice, which though requiring certain modifications to fit them for gold ore crushing, yet are decidedly a step in the right direction—I refer to W. Rasche's, of Melbourne, "direct acting" battery, Husband's and Sholl's Pneumatic stamps and Patterson's "Elephant" stamps. They are all based upon one principle: the battery consists of two stamps only, driven at a great speed (150 to 200 blows per minute), and weighing only 2 to 4 cwt. each, their main differences lying in the means adopted for securing the speed. The perfection of stamping, so far as quantity is concerned, would be gained by allowing each stamp in a battery to work independently, and to surround it on all sides by screens. One reason why some of the stamps in Victoria and America crush so much more than others is, that they have screens both at the back and at the front of the battery. An excellent little stamp for prospecting purposes has been quite lately invented by Dunham. It can be driven by mule or hand power, and is exceedingly portable; the stamp is surrounded by screens, and consequently, permits the maximum of duty to be reached.

The appliances for arresting the gold (both free and pyritous) rendered separable by the stamping operation were then described, these being divided into the mercury or amalgamation methods and the blanket-tables. Under the first head Mr. Lock said :—

A very effective arrangement of blanket-tables and mercury troughs, adopted by the largest Victorian companies, is as follows :—The material leaving the stamps is led into a trough, having a perforated plate at the bottom to keep back any coarse stuff, by which it is easily distributed; thence it passes into three connected troughs, containing mercury, dropping from the first into the second, and from the second into the third. Each of these troughs, is fitted with a splash-board, which, reaching down to within a certain distance of the bottom compels the falling matter to penetrate the mercury more or less before escaping over the lip of the trough. Each trough has a tap hole on one side, by means of which the amalgam may be drawn off. The whole of the contrivance is under lock and key, which prevents stealing. At the end of the blanket-table, another similar trough is placed, through which the material passes before entering the waste-through. The amalgam formed in all these troughs is periodically removed.

The causes of success and failure of the blanket-tables were also described,

as well as the treatment of the blanket sand by barrel amalgamation. The treatment of the tailings, a matter of considerable trouble, and largely neglected in well-paying mines, was then gone into, it being shown how much gold at present lost might be saved. Mr. Lock then described the operations necessary for separating the ore from the pyrites, in which amalgamation also takes a part. Mr, Cosmo Newbery was spoken of as having introduced several improvements in these processes. The paper concluded with some illustrations of failure and success from using unsuitable and suitable sappliances respectively. Regarding the latter we quote the following :—

The first and most prominent example is the well-known Port Philip Co., of Victoria, to whose managing director, Mr. Rivett Bland, the science of gold-mining is much indebted. This company has to raise its ore from a depth of 700 to 1,000 ft. During the past 10 years, it has treated 600,531 tons, the average yielded of which was 5 dwt. 13 gr., the extremes being 3 dwt. 23½ gr. in 1873, and 7 dwt. 21 gr. in 1878. The same company has treated 3,592 tons of pyrites, yielding an average of 4 oz. 3 dwt. 17 gr. of gold, when concentrated. The average total cost of treatment has been £3 13s, 7d. a ton ; the average profit, £13 5s. Another Australian company, getting part of its ore from surface workings, has profitably crushed 283.550 tons, with an average yield of 2 dwt. 22 gr. Another treated 7,453 tons in seven months, with a return of 2 dwt. 10½ gr., and paid £2,101 10s. profit. Another realises a large profit from a yield of only 1 dwt. 14 gr. per ton of ore crushed. But the most remarkable of all is the Imperial Company, at Ballarat, which has treated 2,100 tons of quartz, affording only 21·99 gr, of gold per ton, with a fair margin of profit on the operation ; in other words, it has made money out of material which is only one-tenth part as rich as the non-pyritous material which its neighbours are throwing away.

GOLD IN CEYLON.

(From the *Ceylon Observer*, April 23, 1881.)

It is evident that in the preliminary operations necessary to the development of a gold-mining industry in Ceylon, private enterprise is to do the work with little or no aid from Government. It has been so, to a great extent, in reference to "new products." Vastly different is the relative positions of the Government and private planters in reference to cinchona cultivation, for instance in Java or India and in this island ; and in regard to gold, we have the so-called slow and old-fashioned Indian Government at a very early stage indenting on the services of the highest living authority, Mr. Brough Smyth, for an elaborate survey and report of their supposed auriferous region, while as we have stated, the whilom progressive Executive administration of this island is content to sleep over the business, and to allow the merchants and planters individually to do the best they can to discover whether paying quartz reefs with gold exist in the country. No one can read Mr. Brough Smyth's elaborate report (lying before us as we write), covering 100 folio pages and referring mainly to "the gold mines of the South-Eastern portion of the Wynaud and Carcar Ghaut," without feeling that had Sir Henry Ward or Sir William Gregory administered here in 1879-80, instead of Sir James Longden, an official request for the services of this officer would have been transmitted to Madras long before the general public had begun to

look around for the means of securing professional advice for themselves.

The opportunity, however, for timely official action is past; for we learn on good authority that a Colombo mercantile house, Messrs. Alstons, Scott & Co., have already decided to endeavour to secure the aid and advice of Mr. Brough Smyth in reference to some of the hill properties under their charge. As a preliminary operation, blasting for specimens of the quartz cropping out on Amblakande and other estates in the Dolosbage district is now being carried on, and the resulting specimens will be laid before Mr. Smyth, who, if he considers them favourable, will be asked to visit and report on the district. In other directions practical steps have been taken of much importance. Mr. A. C. Dixon has been sent to the Sabaragamuwa (Rakwana) district on a mission connected with the prospecting for gold as well as gems. It is not unlikely that this enquiry may eventuate in the Ratnapura ("City of Gems") or Sabaragamuwa Gold and Gems Mining Company, Limited, with a London as well as local directorate; but a good deal will depend on the nature of Mr. Dixon's report. In still another direction, the services of Mr. Harvey, a gold-mining authority, have been utilized during his few days' stay in the island. This gentleman has, we believe, paid a hurried visit to the Kadugannawa, Ambagamuwa and Matale districts previous to his departure to-morrow by the French steamer for Europe. We have not heard the result, but from among the quartz specimens sent to this office, Mr. Harvey, a few days ago, picked out one piece (received from Ambagamuwa) as affording favourable indications of a gold-yielding reef. The sand sent to us from the neighbourhood of Nuwara Eliya also favourably impressed Mr. Harvey, for, if auriferous as it appears to be, it could readily be made to give up 90 per cent of the precious metal contained in it. The specimens of quartz sent to us are, however, far too small for the miner's or geologist's purpose: blocks two feet in length would apparently be more to the purpose than pieces of a few inches in size. In a few days we are likely to have another gold prospector and geologist in the island in Mr. Macdonald Cameron, and we trust he will have an opportunity of visiting the interior of the island and obtaining some idea of our supposed auriferous region. The point now is whether the planters in several of the districts within this region should not take common action to ensure a suitable examination of their country. We have received notes of a meeting held by the "Wynaad Planting and Mining Association" on the 16th March last which shews how our neighbours over the water act together. We make a few extracts to indicate that our District Associations in some cases—say in Dolosbage, Ambagamuwa, Rakwana, Matale and Rangala —may well add "Mining" to their "Planting" designation and so treat with Government or gold prospectors as they may deem fit on this new subject of enquiry. The Wynaad planters have, it seems, been asking the Government to do more than it bargained for. We read:—

Gold Minings.—Read reply from the Government of India to the Association's request for the services of a Mining Engineer to report on the district of South Wynaad.

The Government are of opinion that enough has been done on their

part to develop the new Industry and that it must now be left to private enterprise.—Recorded.

The Government of Ceylon could not well answer our District Associations that they had done enough already to develop the gold-mining enterprise. It is satisfactory, however, to learn that in answer to enquiries already made, our local Executive—if they are not prepared to call for Reports,—are inclined to impose the fewest possible restrictions on the new enterprise in connection with the mining rights of the Crown. In this connection we may quote from Mr. Brough Smyth's report to the Madras Government :—

This is not the place to discuss the manner in which lands should be leased for mining purposes, nor would it be right to offer opinions which might be opposed to the policy of the Government, but it is perhaps proper to suggest that regulations should be framed and published under which persons could make applications—

1st.—For licenses giving the right to "prospect" for gold.

2nd.—For leases of lands containing auriferous rocks.

3rd.—For licenses to take and divert water for mining purposes.

The manner in which lands held under the various tenures should be dealt with, the taxes (if any) to be paid by landholders who grant leases for g oldmining purposes, and the method of assessing mining properties are questions solely for the consideration and fiual decision of the Government. It is, however, now well ascertained in countries where gold-mining is an established industry, that the fewer impediments placed in the way of mining enterprise and the lighter the exactions, the more certain are the profits to the revenue. The State gains largely indirectly, and, in sacrificing the revenue which might be obtained directly by laying imposts on the miner, it encourages him in his labors and leads him to undertake explorations which, if he were heavily taxed, he would never contemplate.

At a general meeting of the Nilgiri and Kotergherry Planters' Associations held at Ootacamund on the 31st March last, the following Memorial to the Governor of Madras in reference to Mining Rights was adopted. We extract the portions of interest to us in Ceylon :—

Humbly Sheweth.—That your petitioners are land owners and coffee planters on the Nilgiri Hills and in Wynaad, possessing large tracts ol land held under different tenures. That the development of the mining enterprisc has led your petitioners to examine their titles, especially with reference to mining rights, and having in many cases found that they are pronounced at home to be unsatisfactory and uncertain, your petitioners have determined to represent their grievances to your Excellency's Government, with the earnest prayer that this memorial may receive your Excellency's favourable and very early consideration.

I.—Government Notification, dated 19th October 1880, *re-mining leases.*

The terms laid down in this notification have alrcady been found to be a prohibition of business. Scveral sales of properties have becn hindered by the restrictive terms, thereby causing loss to proprietors, and a complete block to private enterprize. The rule restricting applicants to blocks not exceeding thirty acres is impracticablc, considering that the flatness of most of the Indian reefs gives so small an area of stone to be depended upon for the large expenditure of machinery, even if the lode bc present under the whole thirty acres of surfacc. Added to this is the risk of the stonc, from such small blocks, being worked out before the great expense attached to the crection of such costly machinery can be recouped adjoining blocks in the meanwhile being probably allotted to other applicants.

The following conditions, laid down in the notifications, are also rendering the proper development of reefs on Government land impossible :—

Condition 3.—"That within three months from the date of the execution

of the lease, not less than five labourers per acre shall be regularly employed, during the ordinary hours of labour, on *bonâ fide* mining operations on each block, in such manner as the Government may approve. Returns of the number of labourers employed per diem, shall be sent to the Collector or Commissioner at the expiration of each month."

Condition 4.—"That the lease shall not be sub-let or assigned without the consent of Government being previously obtained."

It has occurred to your petitioners that terms somewhat as follows might be found much more advantageous to Government, and tend to the development of the industry by encouraging private enterprise:—

1.—That prospecting grants be given over a considerable area, say one square mile, for a period of at least six months. This will enable the prospector to learn the strike and dip of the reef on the land he has selected, and whether it is continuous, and it will enable him to secure such portions as he may have found of value, without the fear and risk of his losing the reward of his labour, his neighbours taking advantage of his knowledge.

2.—That a mining lease may be given on the whole, or such portion of the area granted for prospecting as the applicant may select within the above stipulated period of six months.

3.—That there be no restrictions regarding employment of labour.

4.—That if an applicant has satisfactorily provided for the working of any block either by transfer to a Company or otherwise, he may be allowed to apply for and to take up another.

II.—Your petitioners would now address your Excellency with reference to land held on *puttah* tenure. From the notification above referred to it appears that the rules and conditions apply only to Government waste lands, hereafter to be taken up and not yet leased to planters, as it is distinctly addressed to "persons desirous of obtaining permission to mine for gold on Government waste lands in the Wynaad or Nilgiris." It is therefore evident that the orders passed in the notification, cannot have reference to any but Government waste lands, and that the position of holders of land on *puttah* tenure has not yet been defined by Government. Your petitioners would urge that inasmuch as the tenure of land held under *puttah* title is of a permanent nature as regards the term for which the land is held, that Government should, if it is intended to claim any mining rights, specify distinctly the grounds on which they purposed to do so. They submit that as the majority of such lands were held by private individuals prior to the assumption of rights by the British Government it is neeessary that Government should show that these lands were formerly held with some reservation of mining rights. Your petitioners urge that the right to mine or wash for gold was not withheld even by Jemmies, but a tax was imposed on such operations, and that mining was carried on many years ago in Nanjanaad and elsewhere. Your petitioners therefore pray that an order may be passed by Government speedily, distinctly declaring their policy as regards this question, and your petitioners beg further to refer your Excellency to a reputed despatch of the Government of India, No. 7, dated 7th September 1879, to the Secretary of State, which your petitioners have been led to understand distinctly says "that, acting under the opinion of legal advisers, it has been determined that the Crown has no prerogative rights over gold-mines outside the Presidency Town."

[III—is on the subject of land escheated.—ED.]

IV.—Your petitioners embrace this opportunity of bringing to the notice of your Excellency the growing needs of the gold district in Wynaad. Telegraphic communication is urgently required, and has already been represented to the Madras Government, but no steps appear to have been taken to meet this great want. It is difficult to form statistics of the probable returns, but there is no doubt it would amply repay the outlay: each company in Devallah (now about sixteen in number) would probably spend at least R100 a month and there would be a large amount of business, apart from the mining enterprise. The roads, your petitioners would also urge, demand the immediate attention of Government. In the transport of heavy machinery to the mines, great difficulty has been experienced, and your petitioners would

respectfully request that the roads may be put in thorough order, and bridges strengthened between Ootacamund and Neddiwuttum, thence to Devallah and Beypore *via* the Carcoor Ghaut.

V.—In view of the rapid extension of the gold mining industry during the past year, your petitioners would respectfully request that a Gold Commissioner be appointed to secure practical and uniform policy as regards gold mining generally.

On the gold prospects in Southern India generally, it may be remembered that Mr. Brough Smyth summarized his views as follows :—

I hope I have expressed with sufficient distinctness the opinion I entertain respecting the gold fields of South-east Wynaad.

The facts will speak more strongly than words to those acquainted with gold mines. Gold has been found on the south near Eddacurra and on the north near Nellacottah, on the west near Vyteri, and on the east as far as Bolingbroke, that is to say, over an area of more than 500 square miles.

The reefs are very numerous and they are more than of the average thickness of those found in other countries; they are of great longitudinal extent, some being traceable by their outcrops for several miles; they are strong and persistent and highly auriferous at an elevation of less than 500 feet above the sea, and they can be traced thence upwards to a height of nearly 8,000 feet; near them gold can be washed out of almost every dish of earth that is dug; the proportion of gold in some of the soils and reefs in the neighbourhood of Devala is large; and, the country presenting the greatest facilities for prosecuting mining operations at the smallest cost, it must be apparent to all who have given attention to this question that, sooner or later, gold-mining will be established, as an important industry in Southern India.

The retardation of this event will be caused, not by the meagreness of the resources—they are large,—but probably by the mistaken notion that wherever there is gold, all the care, all the forethought that would be deemed requisite in other pursuits may be disregarded in conducting mining operations.

We have little doubt of a report as favourable being the result of a similar examination of much of our hill-country; while in reference to the working of the reefs, the convenience for transporting machinery, the available water power, the supply of labour and the healthfulness of the climate, there can be no question that Ceylon presents very great advantages.

GOLD AND GEMS IN CEYLON.

(From the *Ceyl n Observer*, April 25, 1881.)

We have received from Mr. Auwardt specimens of quartz from his property, Mount Pleasant, near Galle. In these there is no appearance of gold, but a good deal of black mica. In some samples previously furnished, Mr. A. C. Dixon discovered traces of gold. The professional reports of this gentlemen have also been laid before us, and we may extract a few passages to shew his opinion of the prospects of gold reef being found in the Southern Province near Galle. On the 15th December last, Mr. Dixon wrote :—

"I have examined the specimens of gold, gems and bag of sand which I received from you on the 9th instant with the following result :—

"*a*. The small nugget was pure gold and weighed over 6 grains.

"*b*. The stones in the paper parcel were fragments of gems such as corundum, sapphire, garnets, tourmaline, zircon, &c.

"*c* The bag of sand contained fragments of the same mineral as *b*, abounding especially in garnets, I did not find any gold in the sample sent in bag."

On the 27th December, after a personal visit, Mr. Dixon was able to say :—

"I saw the man who found the gold and examined the place from which he

took it. I requested him to dig more and wash it in my presence, after which I examined the residue. I found no trace of gold in it, but numerous fragments of gems and quartz. I then followed up the ravine to its source with the expectation of finding a quartz reef from which the gold might have come. I found two small reefs crossing the ravine and took specimens from them. These I have examined and find only a sligth trace of gold not in quantity to warrant its working. There is evidence of the occurrence of gems in the vicinity. I saw several which had been taken from the opposite side of the hill, and judging from these they appear to be of as good a quality as the gems at Ratnapura but not so large in size. They were chiefly ruby, sapphire, tourmaline and cat's-eye. I have no doubt larger ones will be found. I spoke to your kangani respecting the quartz reefs and have no doubt that if they were broken into, it would set the matter at rest as to whether gold is to be found there in quantity worth working. From what I saw it did not appear to be so."

Again :—

"I have examined the specimens of quartz sent on the 17th March and find in it slight traces of gold at the rate of a few *grains* per ton. There is other metallic matter in the quartz, viz. iron as a sulphide. I have no doubt from what I saw when there that better samples will be sent you."

So far therefore search at Galle has been unsuccessful, although Mr. Dixon holds out encouragement of persevere in blasting for a reef. We trust Mr. Auwardt's further efforts may be crowned with success.

We learn that the result of Mr. Harvey's hurried visit to the Dolosbage, Matale and Ambagamuwa districts has been to leave matters very much as they were, save that certain out-crops of quartz were pronounced non-auriferous and that of other places an opinion was expressed favorable to investigation. Mr. Harvey is a very high authority in the gold-mining world and is naturally, therefore, correspondingly cautious in the expression of his opinion. He was the first, it seems, to inspect and report favourably on the auriferous land belonging to the late firm of Messrs. William Nicol & Co. of Bombay, and his report led to the establishment of the Glenrock and other Gold-mining Companies. His inspection of our hill region was far too hurried to lead to definite practical results. It may, in one sense, be said to be premature, for Mr. Harvey would be the man to call in after some progress was made in the investigation, to give a decisive opinion on the value of quartz, and the nature of a reef. Planters will act quite rightly to make available representative specimens of the quartz which they have reason to suppose to be auriferous; but, as Mr. Harvey pointed out, the proper course in the case of Ceylon where gold has been found in the river beds and nowhere else (to speak of) as yet, would be to pan and wash in the river and follow up so long as gold was found, until at last it disappeared from the washings, and *then* to look right and left and all round for the matrix reef from which the gold had gradually been denuded. Now this is work appertaining to the Government of the country. It is impossible that private individuals can undertake this duty, and we think, therefore, there is good reason for calling on the Lieut.-Governor to devote some portion of the surplus revenue from the Pearl Fishery to an investigation which may be fraught with important consequences to the revenue and prosperity of the Colony. It will be remembered that in 1854 an attempt to follow up the Mahaoya and Hingula in the manner described above, was frustrated by the advent of the south-west monsoon. Unfortunately this same rainy season is again close at hand. Mr. Harvey was greatly struck with the advantages presented to the miner in Ceylon in railway and road communication, water power, good climate, &c. He also expressed an interest in the gem-digging operations in the country and hazarded the opinion that much deeper mining both for gems and gold in suitable localities (as recommended by Sir Samuel Baker in the case of Nuwara Eliya), ought to lead to successful results. The bed of an ancient river, or the old bed of an existing river which has shifted its course, would probably be a favourite spot in which to operate for gold.

It must be remembered that Ceylon is one of the oldest geological forma-

tions. Geologists speculate on this island having been connected with Madagascar and the Malay Peninsula by land long since submerged. They still regard a belt commencing on the east coast of Africa and across Madagascar, Ceylon, Malay Peninsula and Borneo as the most likely division in which to find the remains of the earliest human beings or of the most advanced apes, on the earth's surface. Denudation of the rocks and reefs has therefore been going on in Ceylon far longer than in most countries, and the fact that very valuable gems and evidences of gold have been found so near the surface affords good reason for anticipating greater success from deeper mining.

Since writing the above we have seen Mr. A. C. Dixon on his return from the Rakwana district. The Rangwelletenne limestone with its supposed 90 per cent of lime is a delusion. The limestone Mr. Dixon saw is poor. Gem pits exist on Everton estate to the depth of forty yards, and Mr. Dixon saw finer stones—sapphires chiefly—than any he had previously seen in the island. Two or three were valued by the Chetty owner at over £200 a piece; but Mr. Dixon fully agrees that the proper localities have probably not yet been explored for the best gems, and he is likely to recommend a trial shaft in an old river bed.

GEMS AND LIMESTONE IN THE RAKWANA DISTRICT.

(From the *Ceylon Observer*, April 26, 1881.)

We learn from Mr. Shand, senior, that the Rangwelletenne limestone so well reported on by Mr. Hughes was found in the shape of boulders in the river, and that Mr. Dixon could not find any of similar quality for the good reason that all the best boulders had been collected and used up for estate purposes. There exists, however, a small bed of limestone not far away which runs through native property, and which, had the Superintendent of Rangwelletenne (Mr. G. D. Brabazon) not been absent from the district, he could readily have pointed out to Mr. Dixon. Altogether it is a pity that the geologist's visit to the district was not made known to proprietors generally beforehand. His attention could have been directed to what is supposed to be the richest gemming land in the district, near the Everton ridge, and also on Batakande from which, last year, it is said, £9,000 of precious stones were sold, all taken from an area not exceeding 2½ acres! The old Everton pits which were sunk to a depth of 120 feet had to be abandoned by C. M. Hassana Marikar, because he had no means of pumping out an accumulation of water. It is very evident that there is room with modern appliances and adequate capital for a Limited Company to develop a very profitable Gem-digging industry in the Sabaragamuwa district.

GOLD.

(From the *Encyclopædia Britannica*, Vol. X.)

The colour, lustre, and power of resisting oxidation, which this metal possesses, have caused it to be valued from the earliest ages. Allusions to gold are frequent in the Old Testament, and the refining of the precious metals by cupellation seems to have been a favourite illustration with the Jewish poets.(*a*) Jewellery and vessels found in Egyptian tombs afford evidence of the perfection attained in working gold at a period earlier than the Government of Joseph,(*b*) and drawings on tombs of about this epoch clearly indicate the method of conducting the operations of washing, fusing, and weighing the metal. Excavations in Etruria have brought to light beautiful ornaments of gold, enriched with minute grains of the metal, the workmanship of which was unrivalled until Castellani studied and revived the methods employed by Etruscan artists.(*c*) The Greeks were familiar with natural alloys of silver

a Percy's *Metallurgy of Lead*, p. 177.
b Jacquemart, *History of Furniture*, translation, p. 331.
c *Archæological Journal*, 1861, p. 375.

and gold named *electrum*, rough nuggets of which were frequently stamped, and formed the earliest coins in Lydia.(*a*) The colour of this electrum is pale yellow to yellowish white, and it contains from 20 to 40 per cent of silver.

With regard to the history of the metallurgy of gold, it may be mentioned that, according to Pliny, mercury was employed in his time both as a means of separating the precious metals and for the purposes of gilding. Vitruvius also gives a detailed account of the means of recovering gold, by amalgamation, from cloth into which it had been woven.

Properties.—Gold is the only metal of a yellow *colour*, which is, however, notably effected by small quantities of other metals ; thus the tint is sensibly lowered by small quantities of silver, and heightened by copper. The surface colour of particles of gold is often apparently reddened by translucent films of brown iron ore. It is nearly as soft as lead. The *hardness* varies, however, with the composition. Crystallized specimens from Oregon and Fraser River, containing respectively 835 and 910 parts of gold in 1,000, are slightly harder than calc spar but sensibly softer than fluor spar, or much harder than the pure metal. When pure, gold is the most *malleable* of all metals. One grain may be beaten into leaves which cover a surface of 56 square inches, and are only $\frac{1}{282000}$th of an inch thick. Faraday has shown that the thickness of gold leaves may be still further reduced by floating them on a dilute solution of cyanide of potassium. When very thin, leaf gold appears yellow by reflected and green by transmitted light. If, however, certain gold films are heated, the light transmitted is ruby red ; the pressure of a hard substance on the film so changes its state of aggregation that green light is again transmitted.(*b*) The metal is extremely *ductile* ; a single grain may be drawn into a wire 500 feet in length, and an ounce of gold covering a silver wire is capable of being extended more than 1,300 miles. Gold can readily be welded cold, and thus the finely-divided metal in the state in which it is precipitated from solution may be compressed between dies into discs or medals. According to G Ross,(*c*) the *specific gravity* of gold in the finely-divided state in which it is precipitated from solution by oxalic acid is 19·49. The specific gravity of cast gold varies from 18·29 to 19·37, and by compression (*d*) between dies the specific gravity may be raised from 19·37 to 19·41 ; by annealing, however, the previous density is to some extent recovered, as it then is found to be 19·40. Its *atomic weight* is variously given as follows:—196·67 (Berzelius), 196·3 (Levol), 196·5 (Wurtz), 196·0 (Watts). The number adopted in this work (CHEMISTRY, vol. v., p. 528) is 196·2. Different observers have given the following temperatures as its *melting point* :—1,425° (C. Daniell), 1,200° C. (Pouillet), 1,380° C. (Guyton de Morveau). Rimesdijk,(*e*) after comparing the several results, concludes that it may be considered to be 1,240° C. The *electric conductivity* is given by Matthiessen as 73·99 at 15·1° C., pure silver being 100 ; this depends greatly on its degree of purity,—the presence of a few thousandths of silver lowering its conductivity by ten per cent. The *specific resistance* of the metal in electromagnetic measure, according to the centimetre-gramme-second system of units, is 2,154. Its *conductivity for heat* is 53·2 (Wiedemann and Franz), pure silver being 100. Its *specific heat* is 0·324 (Regnault). Its *co-efficient of expansion* for each degree between 0° and 100° C. is 0·000014661, or for gold which has been annealed 0·000015136 (Laplace and Lavoisier). The *specific magnetism* of the metal is 3·47 (Becquerel). Details as to its *tenacity* and *rigidity* are given in the article ELASTICITY. With regard to its *volatility*, Gasto Claveus (*f*) states that he placed an ounce of pure gold

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a "Notes on the Ancient Electrum Coins," by Barclay V. Head, *Numismatic Chronicle*, part iv., 1875, p. 245.

b Phil. Trans., 1857, p. 145.

c Pogg. Ann., vol. lxxiii. p. 1, and lxxv. p. 408.

d Eighth Ann. Report of Deputy Master of the Mint, 1877, p. 41.

e Archives Néerlandaises, t. iii., 1868.

f Quoted by Dr. T. Thomson, *System of Chemistry*, 5th edition, 1817, vol. i., p. 484.

in an earthen vessel in that part of a glass-house where the glass is kept constantly melted, and retained it in a state of fusion for two months without the loss of the smallest portion of its weight. Kunkel describes a similar experiment, which was attended with the same result. Homberg,(*a*) however, observed that when a small portion of gold is kept at a violent heat, part of it is volatilized. Both Macquer and Lavoisier showed that when gold is strongly heated, fumes arise which gild a piece of silver held in them. Its volatility has also been studied by Elsher, and, in the presence of other metals by Napier.(*b*) Hellot affirms that when an alloy of 7 parts of zinc and 1 part of gold is heated in air, the whole of the gold rises in the fumes of oxide of zinc which are produced. Gold is dissipated by sending a powerful charge of electricity through it when in the form of leaf or thin wire. In the gold *spectrum* Huggins has observed twenty-three lines, and the wave lengths of the three most important of these are 5,231, 5,835, and 6,276 respectively. Some preliminary observations on the spectrum of the vapour at the temperature of the oxyhydrogen flame, made by Lockyer and Roberts,(*c*) showed that there was a distinct absorption both at the blue and at the red end.

The solvents for gold are given in the article CHEMISTRY, vol. v. p. 529. It may be added that finely-divided gold dissolves when heated with strong sulphuric acid and a little nitric acid. Dilution with water, however, precipitates the metal as a violet or brown powder from the solution so obtained. Gold is also attacked when strong sulphuric acid is submitted to electrolysis with a gold positive pole (*d*) W. Skey has shown (*e*) that in substances which contain small quantities of gold, the precious metal may be removed by the solvent action of a tincture of iodine or bromine in water. Filter paper soaked with the clear solution is burnt, and the presence of gold is indicated by the colour of the ash.

Occlusion of Gas by Gold.—Graham has shown (*f*) that gold is capable of occluding 0·48 of its volume of hydrogen, and 0·20 of its volume of nitrogen. Varrentrapp has also pointed out that "cornets" from the assay of gold may retain gas if they are not strongly heated. Artificial crystals of gold may be formed when the molten metal is slowly cooled.

Occurrence and Distribution.—Gold is found in nature chiefly in the metallic state, or as native gold, and less frequently in combination with tellurium, lead, and silver, forming a peculiar group of minerals confined to a few localities in Europe and America. These are the only certain examples of natural combinations of the metal,—the minute although economically valuable quantity often found in pyrites and other sulphides being probably only present in mechanical suspension, although for practical purposes it may be spoken of as combined. The native metal occurs tolerably frequently in crystals belonging to the cubic system, the octahedron being the commonest form, but other and complex combinations have been observed. Owing to the softness of the metal, large crystals are rarely well defined, the points being commonly rounded. In the irregular crystalline aggregates branching and moss-like forms are most common, and in Transylvania thin plates or sheets with diagonal structures are characteristic. These have recently been shown by Vom Rath to be repeated combinations of distorted tetrahexahedra. During the preparation of a mass of pure gold in the Mint at London, some fine crystals which appear to be aggregations of octahedra were obtained; and dendritic crystals of gold prepared artificially, have been described by Chester. It is possible also to obtain gold in crystals by heating its amalgam; according to Knafll, an amalgam of 1 part of gold with 20 parts of mercury is maintained at a temperature of 80° C for eight days. It is then

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a Mem. Paris Academy, 1702, p. 147.
b Chem. Soc. Journ., vol. x. p. 229, vol. xi. p. 168.
c Proc. Roy. Soc., 1875, p. 344.
d Spiller, *Chem. News*, x. 173.
e Ibid., xxii. 245.
f Phil. Trans., 1866, 133.

heated to 80° C. with nitric acid of specific gravity 1·35, when dull crystals will be left, which become brilliant when more strongly heated. More characteristic, however, than the crystallized are the irregular forms, which, when large, are known as "nuggets" or "pepites," and when in pieces below ¼ to ½ ounce weight as gold dust, the larger sizes being distinguished as coarse or nuggety gold, and the smaller as gold dust proper. Except the larger nuggets, which may be more or less angular, or at times even masses of crystals, with or without associated quartz or other rock, gold is generally found bean-shaped or in some other flattened form, the smallest particles being scales of scarcely appreciable thickness, which, from their small bulk as compared with their surface, subside very slowly when suspended in water, and are therefore readily carried away by a rapid current. These form the "float gold" of the miner. The physical properties of native gold are generally similar to that of the melted metal, and its alloys as described above. The composition varies considerably in different localities, as shown in the following table :—

ANALYSES OF NATIVE GOLD FROM VARIOUS LOCALITIES.

Locality.	Gold.	Silver.	Iron.	Copper.	Authority.
EUROPE.					
British Isles—					
Vigra and Clogau	90·16	9·26	trace	trace	Forbes.
Wicklow (river)	92·32	6·17	·78	..	Mallet.
Transylvania..... ...	60·49	38·74	...	0·77	G. Rose.
ASIA.					
Russian Empire—					
Brezovsk.....	91·88	8·03	trace	·09	G. Rose.
Ekaterinburg.....	98·96	0·16	·05	·35	...
AFRICA.					
Ashantee	90·05	9·94	...	...	...
AMERICA.					
Brazil	94·0	5·85	...	..	D'Arcet.
Central America	88·05	11·96	...	...	Fremy and Pelouze.
Titiribi	76·41	23·12	...	0·87	Rose.
California	90·12	9·01	...	...	..
Mariposa	81·00	18·70	...	...	F. Claudet.
Cariboo	84·25	14·90	.	·03	Claudet
AUSTRALIA.					
South Australia	87·78	6·07	6·15	...	A. S. Thomas.
Ballarat	99·25	0·65	...	...	Claudet.

Of the minerals containing gold the most important are sylvanite or graphic tellurium, of composition (AgAu) Te, with 24_2 to 26 per cent; calaverite, $AuTe_2$, with 42 per cent; and nagyagite or foliate tellurium, of a complex and rather indefinite composition, with 5 to 9 per cent of gold. These are confined to a few localities, the oldest and best known being those of Nagyag and Ofenbanya in Transylvania; but latterly they have been found in some quantity at Red Cloud, Colorado, and in Calaveras county, California—the nearly pure telluride of gold, calaverite, being confined to these places.

The minerals of the second class, usually spoken of as auriferous, or containing gold in sensible quantity, though not to a sufficient amount to form an essential in the chemical formulæ, or even in many instances to be found

in the quantities ordinarily operated upon in analyses, are comparatively numerous, including many of the metallic sulphides. Prominent among these are galena and iron pyrites,—the former, according to the observations of Percy and Smith, being almost invariably gold-bearing to an extent that can be recognized in operating upon a pound weight of the lead smelted from it, the proportion increasing to some extent with the amount of silver.(*a*) The second is of greater practical importance, being in some districts exceedingly rich, and, next to the native metal, is the most prolific source of gold. Magnetic pyrites, copper pyrites, zinc blende, and arsenical pyrites are other and less important examples,—the last constituting the gold ore formerly worked in Silesia. A native gold amalgam is found as a rarity in California, and bismuth from South America is sometimes rich in gold. Native arsenic and antimony are also very frequently found to contain gold and silver.

The association and distribution of gold may be considered under two different heads, namely, as it occurs in mineral veins, and in alluvial or other superficial deposits which are derived from the waste of the former. As regards the first, it is chiefly found in quartz veins or reefs traversing slaty or crystalline rocks, usually talcose or chloritic schists, either alone, or in association with iron, copper, magnetic and arsenical pyrites, galena, specular iron ore, and silver ores, and more rarely with sulphide of molybdenum, tungstate of calcium, bismuth, and tellurium minerals. Another more exceptional association, that with bismuth in calcite from Queensland, was described by the late Mr. Daintree. In Hungary, the Urals, and Northern Peru, silicates and carbonates of manganese are not uncommonly found in the gold and silver bearing veins. In the second or alluvial class of deposits, the associated minerals are chiefly those of great density and hardness, such as platinum, osmiridum, and other metals of the platinum group, tinstone, chromic, magnetic, and brown iron ores, diamond, ruby, and sapphire, zircon, topaz, garnet, &c, which represent the more durable original constituents of the rocks whose disintegration has furnished the detritus. Native lead and zinc have also been reported among such minerals, but their authenticity is somewhat doubtful.

The distribution of gold-bearing deposits is world-wide; although the relative importance of different localities is very different, their geological range is also very extensive. In Europe the principal groups of veins are in slaty or crystalline schists, whose age, when it can be determined, is usually Palæozoic, Silurian, Devonian, or Carboniferous, and less commonly in volcanic formations of Tertiary age. The alluvial deposits, being more extensive, are less intimately connected with any particular series of rocks. Few of either are, however, of much importance as compared with the more productive deposits of America and Australia. In the United Kingdom gold-bearing quartz veins were worked during the Roman occupation at Ogofau, near Llanpumpsant, in Carmarthenshire; and in the year 1863 as much as 5,300 oz. was produced from similar veins in Lower Silurian slates at Vigra and Clogau mines, near Dolgelly. In 1875 the mine was re-opened, and in 1878 it produced 720 oz. Tetradymite, native bismuth, and several other characteristic associates of gold were also found in small quantity. In Cornwall small pieces of native gold have at intervals been found in alluvial or stream tin works; and similar but more important finds have been made in the granite district of Wicklow, and more recently at Helmsdale, in Sutherlandshire. The largest nugget of British origin weighs under 3 oz.

On the continent of Europe the great rivers originating in the crystalline rocks of the Alpine region, such as the Rhine and Danube, are slightly auriferous in their alluvial deposits in several places; but the proportion of gold is extraordinarily minute, so that the working is only carried on by gipsies, or by the local peasantry at irregular intervals, the return for the labour expended being very small. The same remark applies to the Rhone and its affluents, and the rivers of the central granitic mass of

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(*a*) *Phil. Mag*, viii., 1854, p. 126.

France. In the Austrian Alps the gold quartz mines at the Rathausberg, near Gastein, at a height of about 9,000 feet above the sea-level, and at Zell, in Tyrol, are of interest historically as having developed the system of amalgamation in mills, although they are economically of small importance at present. On the Italian side, in the Valanzasca and Val Toppa above Lago Maggiore, a group known as the Pestarena mines have yielded from 2,000 to 3,000 ounces annually for several years past; and more recently a discovery of great interest of a highly auriferous copper ore has been made at Ollomont in the Val d'Aosta. In Hungary the gold-bearing veins of Schemnitz occur in greenstones and trachytes of Tertiary age, the most powerful example, the *Spitaler-gang*, being filled with a mixture of quartz and brown iron ore known as zinnopal, and containing gold associated with silver ores, galena, and pyrites. In Transylvania, at Nagyag, the gold-bearing tellurium minerals previously noticed are found in small veins traversing greenstone trachyte. These are often very thin, as low as $\frac{1}{8}$th to 1-16th of an inch, but each is carefully traced out, the rock being impregnated with gold and silver to a certain depth on each side. At Vorospatak, another Transylvanian locality, gold with a very large proportion of silver and associated with gypsum is worked in veins traversing a Tertiary sandstone, being almost the only known instance of such a mode of occurrence.

The Russian empire has the largest gold production among the countries of the Old World, most of the produce, however, being derived from its Asiatic territories. The more important localities are situated on the eastern slope of the Ural chain, extending in a nearly north and south line for more than 600 miles from 51° to 60° N. lat. The chief centres are Miask (55° N.), Kamensk (56° 30′ N.), Berezovsk (57° N.), Nijne Tagilsk (58° N.), and Bogoslowsk (60° N.), the known deposits, which include both veins and alluvial mines, extending for about one degree farther north. The geological age of the Ural veins is not very well defined—strata of the Silurian, Devonian, and Carboniferous periods, which form regular parallel alternations on the European slope, being present on the Asiatic side, but in much disturbed and contorted positions, in association with plutonic rocks, diorite, diabase, and granite, with which the gold veins are intimately connected. The latter are therefore of post-Carboniferous and probably of Permian date. At Berezovsk the mines cover an area of about 25 square miles, mainly composed of talcose, chloritic, and clay slates, vertical or sloping at high angles, and penetrated by dykes of beresite, a fine grained rock made up of quartz and white mica with some felspar and pyrites, the latter usually transformed into brown iron ore. These dykes, which have a general north-and-south direction are vertical, and are from 20 to 70 feet and upwards in thickness, are traversed perpendicularly to their direction by veins of quartz from the thinnest string to a maximum of $3\frac{1}{2}$ or 4 feet thick, in which gold is associated with brown iron ore or ochres, resulting from the decomposition of pyrites. The workings being essentially shallow, none of the associated sulphides, galena, disulphide of copper, &c., have as yet been found, as a rule, to be gold-bearing. The valuable parts of the veins are almost entirely restricted to the beresite dykes. The richest of the Ural mines are those of Smolensk, near Miask, and Ouspensk, near the village of Katchkar, in 52° N. The alluvial deposits which, though called sands, are but very slightly sandy clays, extend to the north beyond the inhabited regions, and to the south into the Cossack and Bashkir countries. The most valuable diggings are in the district of Miask, where the largest nuggets have been found, and in the Katchkar, which are remarkable for the great number of gems, pink topazes, emeralds, &c., found in connexion with the gold. Magnetite, quartz, and platinum are very common in all the Ural gold sands; less common are hematite, titaniferous and chromic iron, pyrites, garnet, and, least of all zircon, kyanite, and diamond. These alluvial deposits are of later Tertiary age, some of them containing traces of prehistoric human work; others are post-Pliocene, with the remains of the mammoth, tichor-

rhine, rhinoceros, and other mammalian fossils. Somewhat similar conditions prevail in the alluvial gold region of the Altai. Besides the veins and alluvial deposits, the Ural rocks, such as serpentine, diorite, beresite, agrairite, &c., are at times auriferous.

The gold deposits of the Caucasus, though immortalized in the tradition of Jason and the Argonauts, are now entirely abandoned, the last attempt at working them having being suspended in 1875.

In India gold is obtained in small quantities by native gold-washers in various parts of the highlands of southern Bengal, and more recently quartz veins and alluvial deposits of considerable promise have been discovered in the district of Wynaad, in the southern part of the Madras presidency.

On the Atlantic slopes of North America, the chief gold-bearing localities are on the Chaudière river, near Quebec, and in Nova Scotia. In both instances the quartz veins worked are contained in slates belonging to the Quebec group of the Lower Silurian period, those of the latter province being specially remarkable for their quasi-stratified character, as they penetrate the slates at a very low angle of inclination, and have been folded and corrugated together with the containing rocks by subsequent disturbances. Other deposits of old geological periods are found in Tennessee and North Carolina.

On the Pacific side of America gold is found under very different conditions and on a much larger scale than on the Atlantic side. The whole distance from Mexico to Alaska may be said to be more or less auriferous, the most extensive deposits being in the great north-and-south valley of the Sacramento, which runs parallel to the coast, between the so-called Coast Mountains and the Sierra Nevada, the latter being distinguished further to the north in the Cascade range. Others of less extent are known in the Klamath, Columbia, and Fraser River basins; they extend in the last two far back into the interior, to the region between the Cascade range and the Rocky Mountains. In many of these valleys alluvial deposits are developed to an extent unparalleled elsewhere, the river channels being bordered by banks or benches of gravel and sand, rising in terraces to considerable heights on the flanks of the hills. For example, at the Methow, a tributary of the Columbia, there are sixteen lines of such terraces, the highest about 1,200 feet above the river; and at Colville, on the Columbia, traces of old terraces, much degraded by frost and rain, are seen at 1,500 feet above the river. These gravels, which are of Pliocene and more recent origin, are in many places, though very unequally auriferous, the richest points being found in the bars or shingle banks of the river after the summer floods, and in the channels of the smaller tributary streams, where the poorer material has been partially enriched by a process of natural washing. The most extensive, or rather the best known because most completely explored, deposits of this class are those of the Upper Sacramento valley, in California (see vol. iv., p. 701).(*a*) Others of considerable importance are worked in the Cariboo district on the Upper Fraser River, yielding very coarse gold. Another discovery of a singular character, the produce being a regular gold gravel, was made some years back at Salmon River in Oregon, but the deposit, though exceeding rich, was soon exhausted. Gold-bearing quartz veins are also common over a large part of California, notably in Grass Valley (vol. iv., p. 702), in strata that are supposed to be of Triassic age, the associated minerals being iron and arsenical pyrites, galena, &c. In Calaveras county, tellurium ores like that of Transylvania are characteristic of the gold veins. In the adjacent States of Nevada and Colorado, gold is so intimately associated with silver ores, that it is for the most part only obtained from the ultimate process of refining the reduced silver. The same remark applies to the most of the mines of Mexico, and on the south-west coast of America, in Peru, Bolivia, and Chili. (See SILVER.)

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a See also Whitney, *On the Auriferous Gravels of the Sierra Nevada*, Cambridge, U. S., 1879.

Very rich gold quartz has been brought from Carabaya on Lake Titicaca; and recently considerable deposits both alluvial and in veins have been opened at Caratal in Venezuela and at St. Elie in French Guiana, which are interesting as proving the actual existence of Raleigh's Eldorado.

In Brazil the principal gold mines are upon veins in clay slate, and a peculiar class of rocks known as Jacotinga or Itabirite, and which are mixtures of quartz, chlorite, and specular iron ore, the latter often occurring in large mirror-like crystals several inches across. The gold occurs almost entirely in pyritic minerals, being most abundant in ordinary iron pyrites, and less so in magnetic and arsenical pyrites, free gold being rarely seen. (See BRAZIL, vol. iv., p. 224.)

In Africa the chief gold-bearing localities are on the west coast—gold dust derived from alluvial washings forming an article of export from many of the trading stations along the Guinea coast. Latterly, alluvial deposits have been worked in the mountains of Transvaal, in the Leydenburg district (25° S. lat. 31° E. long.), producing coarse nuggetty gold in masses up to 11 lb weight, and in a few cases gold-bearing quartz has been found in veins in talcose schist and quartzite, closely associated with eruptive masses of diorite. The age of these rocks is considered by Dunn (*a*) to be Silurian or Devonian, and the observed phenomena to be similar to those generally observed in Australia. The upper valley of the Nile produces a little gold in Abyssinia and Nubia, the latter being the land of gold of the old Egyptians. Very extensive ancient mines have been described by Linant Bey in the district known as Attaki or Allaki on the Red Sea, situated about 120 miles back from Ras Elba, the headland midway between Berenice and Sauwakin. These are propably the same mines that were described by Diodorus Siculus, and one of the oldest topographical documents known, a map or itinerary of the route to them from the Nile, is preserved at Turin. In the reign of Setee I., of the 19th dynasty, wells were opened along this route, in order that the mines, that were then of very great antiquity, might be reopened.(*b*) Similar ancient gold mines have recently been discovered by Burton in the land of Midian, on the east coast of the Gulf of Akaba.

The gold districts of Australia cover a very considerable area, extending from the east side of the continent for about 20° of latitude (18° to 38° S.), the more important deposits being those of Victoria in the South. The principal districts are in Victoria,—Ballarat, Castlemaine, and Sandhurst, lying west and north from Melbourne, and Beechworth near the Murray River to the north-east. In New South Wales the gold-fields are scattered over the entire length of the colony from north to south, the more important districts lying between the 32nd and 36th parallels of S. lat. on the western side of the Australian cordillera, on the upper tributaries of the Macquarie and Lachlan rivers, the centre being about the town of Bathurst. This is known as the western district. Another group, known as the northern district, is on the eastern side of the mountains near the Queensland boundary, in 29° S., Rocky River being the principal locality: while the southern district includes Braidwood, Adelaide, Tumbarumba, and other localities near the Murray River. In Queensland the chief localities are, commencing on the south, Gympie and Kilkevan near Maryborough, 26° S. lat.; a group extending about 50 miles north and south of Rockhampton, in 24° 30′ S. lat., all near the coast; Eastern River, Hurley, and Peak Downs about 300 miles inland on the 23rd parallel; and Clomenny and Gilbert on a stream running in to the Gulf of Carpentaria, besides numerous others. In all those localities two principal kinds of deposits are observed, namely, auriferous quartz veins traversing slates of Silurian and Devonian age, which are in intimate relation with masses of diorite and other eruptive rocks; and gold-bearing drifts

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a Quarterly Journal of the Geological Society, xxxiii. p. 882.

b Mariette Bey, *Histoire Ancienne d' Egypt*, 1867, p. 96. The oldest notice of the mines goes back to the 12th dynasty.

of Miocene or even newer Tertiary date, derived from the degradation of the older strata. According to Daintrec,(*a*) no auriferous vein of any kind has been found in any Secondary or Tertiary strata, or in the igneous rocks erupted through any such newer formations; and as a result of his experience, the same observer gives the following as the modes of occurrence of gold in Australia:—(1) In pyritic diorites and felstones in Queensland, and their alluvial drifts; (2) in pyritic granites in New South Wales; (3) in drifts from auriferous serpentine in Queensland, also in the two northern colonies; (4) in more or less regular veins with quartz and calcspar in the preceding rocks; (5) in quartz and other veins in Devonian and Upper Silurian strata in proximity to similar igneous rocks, which is the general character of the Victoria quartz veins; (6) in veins of metamorphic rocks of unknown age in Queensland; and (7) in quartz veins in Lower Silurian strata, without any apparent connexion with igneous masses. The latter occur only in Victoria, and are of comparatively minor importance. In the northern territory of South Australia, alluvial gold mining has recently been developed to a considerable extent in the neighbourhood of Port Darwin in the Gulf of Carpentaria, the export being from 2,000 to 3,000 oz. monthly.

Statistics.—There are no means of stating exactly the total gold produce of the world for any particular year, as in many of the larger producing coundries no systematic returns are obtained, and in others where such returns are collected, their publication is often delayed for a considerable time. The following figures, mostly derived from a recent statistical work, A. Soetbeer, *Edelmetall-Produktion*, 1879, with some additions from late official sources, will give some idea of the relative importance of the different countries. Previous to 1837 the first place was held by Russia, and the estimated average annual yield from all sources was in the decennial period 1841-50, 1,760,500 ounces.

The contributions of the different countries are as follows:—

		oz.		oz.		oz.
United States	1876,	2,050,000 (*b*)				
Russia	1876,	1,072,920	1877,	1,281,260		
New South Wales	1876,	126,789	1877,	97,582		
Victoria	1876,	963,760	1877,	809,653	1878,	758,039
Queensland	1876,	410,330	1877,	468,418		
New Zealand	1876,	322,016	1877,	371,685	1878,	311,438
Venezuela					1878,	150,000
New Granada	1876,	112,500				
Africa	1875,	110,100				
Mexico	1875,	65,950				
Bolivia	1875,	64,300				
Austria-Hungary	1876,	61,214				
Brazil	1875,	55,300				
Japan	1876,	21,660				
Chili	1876,	12,860				
Nova Scotia	1876,	12,039				
Peru	1876,	11,570				

Since 1851 the yield has been very largely increased by the discovery of the Australian and Californian sources, the annual averages being—

In 1851...1855...	6,350,180	ounces
,, 1856...1860...	6,624,850	,,
,, 1861..1866..	5,951,770	,,
,, 1866...1870...	6,169,660	,,
,, 1871...1875...	5,487,400	,,

a Quarterly Journal of the Geological Society, vol. xxxiv. p. 435.

b The two principal mines, on the Comstock lode, the Consolidated Virginia and California, produced, apart from silver, gold of the value in United States currency as follows:—

	1876.	1877.	1878.
Consolidated Virginia	$7,378,145	$6,270,000	$3,770,000
California	6,648,641	9,386,745	5,553,400

Proportion of Gold in Deposits.—A rich gold-bearing deposit is quantitatively very different from one to which the same term is applied when containing ores of other metals. In the latter the useful material must as a rule form a considerable proportion—one or more parts in a hundred—of the mass; while in the former, owing to the superior value of the product, it rarely attains as much as 1 per cent, and is generally very much less, the amount of gold contained in easily-worked alluvial deposits being often extremely small. For example, the yield of the Siberian gold washings ranges from 12 grains to 1 dwt. 12 grains per ton; (*a*) while in the lodes, which are more difficult and expensive to work, the proportion is about 8 dwts. per ton. In the alluvial washings of California it is estimated at about two shillings worth, equal to about 1-40th of an ounce, per ton of gravel. In Australia the alluvial ground worked in the colony of Victoria in 1878 is returned as averaging 25 grains (1 dwt. 1 gr.) per ton, or about double the above quantity.

In vein mining, which is more difficult and costly, a larger yield is necessary, but probably 5 dwts., or about £1 in value per ton, will in most places represent paying quantities from quartz containing free gold, *i. e.*, not associated with pyrites. The proportional yield and quantities of the different kinds of auriferous materials treated in the colony of Victoria during the last three months of 1878 were—

	Tons.	Yield per ton. oz.	dwt.	gr.
Alluvial sand "washdirt"	173·379	1	1	59·6
Cement (gravel) requiring crushing ...	5871	...	4	21·4
Quartz	222·775	...	9	21
Quartz tailings	11.139	...	1	18
Pyrites and blanketing (ore collected on blanket tables)	1·599	2	6	13·7

In the less tractable minerals, such as arsenical pyrites occurring in the lower portions of the veins, as much as 1½ to 3 oz. may be required for profitable working. When associated with the ores of other metals, such as silver, lead, and copper, the extraction of the gold is in most cases an incidental and final operation in their metallurgical treatment, and may therefore be best considered in the articles on these metals.

Mining.—The various deposits of gold may be divided into two classes—"veins" and "placers." The vein mining of gold does not greatly differ from that of similar deposits of metals. It will only be necessary to refer here to certain details of the extraction of gold in such cases. In the placer or alluvial deposits, the precious metal is found usually in a water-worn condition imbedded in earthy matter, and the method of working all such deposits is based on the disintegration of the earthy matter by the action of a stream of water, which washes away the lighter portions and leaves the denser gold. In alluvial deposits the richest ground is usually found in contact with the "bed rock"; and, when the overlying cover of gravel is very thick, or, as sometimes happens, when the older gravel is covered with a flow of basalt, regular mining by shafts and levels, as in what are known as tunnel-claims, may be required to reach the auriferous ground. In the early days of gold washing in California and Australia, when rich alluvial deposits were common at the surface, the most simple appliances sufficed; the most characteristic being the "pan," a circular dish of sheet iron with sloping sides about 13 or 14 inches in diameter. The pan, about two-thirds filled with the "pay dirt" to be washed, is held in the stream or in a hole filled with water. The miner, after separating the larger stones by hand, imparts a gyratory motion to the pan by a combination of shaking and twisting movements which it is impossible to describe exactly, so as to keep its contents suspended in the stream of water, which carries away the bulk of the lighter material, leaving a black residue consisting of magnetic iron ore and

a 1 dwt per ton corresponds to 1 part in 653,333 by weight, and about 1 in 5 or 6 millions by volume.

other heavy minerals, together with any gold which may originally have been present in the mass. The washing is repeated until enough of the enriched sand is collected, when the gold is finally recovered by careful washing or "panning out" in a smaller pan. In Mexico and South America, instead of the pan, a wooden dish or trough, variously shaped in different districts, and known as "batea," is used.

The "cradle," a simple appliance for treating somewhat larger quantities, varies in length from 3 feet 6 inches to 7 feet, but the shorter length is that usually adopted. Its nature will be evident from fig. 1, in which *a* is a movable hopper with a perforated bottom of sheet iron in which the "pay dirt" is placed. Water is poured on the dirt, and the rocking motion imparted to the cradle causes the finer particles to pass through the holes in the hopper on to the screen *b*, which is of canvas, and thence to the base of the cradle, where the auriferous particles accumulate on the transverse bars of wood *c*, called "riffles." Washing by the cradle, which is now but little used except in preliminary workings, is tedious and expensive.

The "tom" is a sort of cradle with an extended sluice placed on an incline of about 1 foot in 12. The upper end contains a perforated riddle plate which is placed directly over the riffle box, and under certain circumstances mercury may be placed behind the riffles. Copper plates amalgamated with mercury are also used when the gold is very fine, and even in some instances amalgamated silver coins have been used for the same purpose. Sometimes the stuff is disintegrated with water in a "puddling machine," which is used, especially is Australia, when the earthy matters are tenacious and water scarce. The machine frequently resembles a brickmaker's wash-mill, and is worked by horse or steam power.

In workings on a larger scale, where the supply of water is abundant, as in California, sluices are generally employed. They are shallow troughs about 12 feet long, about 16 to 20 inches wide, and 1 foot in depth. The troughs taper slightly, so that they can be joined in series, the total length often reaching several hundred feet. The incline of the sluice varies with the conformation of the ground and the tenacity of the stuff to be washed, from 1 in 16 to 1 in 8.

Fig 2 represents one of the simplest forms of sluice as used in river diggings in the north-west of America. A rectangular trough of boards, whose dimensions depend chiefly on the size of the planks available, is set up on the higher part of the ground at one side of the claim to be worked, upon trestles or piers of rough stone-work, at such an inclination that the stream may carry of all but the largest stones, which are kept back by a grating of boards about 2 inches apart at *a*. The gravel, which in this particular instance is from 12 to 16 feet thick, and with an average breadth to the river of 25 to 30 feet, is dug by hand and thrown in at the upper end, the stones kept back being removed at intervals by two men with four-pronged steel forks. The floor of the sluice is laid with riffles made of strips of wood 2 inches square laid parallel to the direction of the current (as at *b*, and in cross section at *c*), and atother points *d* with boards having transverse notches filled with mercury. These were known originally as Hungarian riffles. The bottom of the working, which is below the drainage level of the valley, is kept dry by a Chinese bucket pump *e*, attached to a rough undershot wheel driven by the current in the sluice. The sluice boxes are made in lengths, and united together spigot and faucet fashion, so that they may easily be removed and re-erected as the different parts of the claim are progressively exhausted.

In the larger and more permanent erections used in hydraulic mining, the upper ends of the sluices are often cut in rock or lined with stone blocks, the grating stopping the larger stones being known as a "grizzly." In order to save very fine and especially rusty particles of gold, so-called "under-current sluices" are used; these are shallow wooden tanks, 50 square yards and upwards in area, which are placed somewhat below the main sluice, and communicate with it above and below, the entry being protected by a grating, so that only the finer material is admitted. These are paved with

stone blocks or lined with mercury riffles, so that from the greatly reduced velocity of flow, due to the sudden increase of surface, the finer particles of gold may collect. In order to save finely-divided gold, amalgamated copper plates are sometimes placed in a nearly level position, at a considerable distance from the head of the sluice, the gold which is retained in it being removed from time to time. Sluices are often made double, and they are usually cleaned up,—that is, the deposit rich in gold is removed from them,—once a week. The gold is then recovered by "panning."

The application of a jet of water to the removal of auriferous gravels by the so-called hydraulic system of mining has already been noticed at vol. iv., p. 701.(*a*) This method has for the most part been confined to the country of its invention, California, and the western territories of America, where the conditions favourable for its use are more fully developed than elsewhere,—notably the presence of thick banks of gravel that cannot be utilized by other methods, and abundance of water, even though considerable work may be required at times to make it available. The general conditions to be observed in such workings may be briefly stated as follows:—(1) The whole of the auriferous gravel, down to the "bed rock," must be removed,—that is, no selection of rich or poor parts is possible; (2) this must be accomplished by the aid of water alone, or at times by water supplemented by gunpowder; (3) the conglomerate must be mechanically disintegrated without interrupting the whole system; (4) the gold must be saved without interrupting the continuous flow of water; and (5) arrangements must be made for disposing of the vast masses of impoverished gravel.

The general appearance of an hydraulic gold working is seen in fig. 3, the water being brought from a ditch on the high ground, and through a line of pipes to the distributing box, whence the branch pipes supplying the three jets diverge. The stream issues through a nozzle resembling that of a fire engine (fig 4), which is movable in a horizontal plane around the vertical axis *a*, and in a vertical plane on the spheric l joint and centre *b*, so that the direction of the jet may be varied through considerable angles by simply moving a handle. The material of the bank, being loosened by the cutting action of the water, crumbles into holes, or "caves in," and the superincumbent mass, often with large trees and stones, falls into the lower ground. The stream, laden with stones and gravel, passes into the sluices, where the gold is recovered in the manner already described. Under the most advantageous conditions the loss of gold may be estimated at 15 or 20 per cent, the amount recovered representing a value of about two shillings per ton of gravel treated. The loss of mercury is about the same, from 5 to 6 cwt. being in constant use per mile of sluice. About 1 cwt. is added daily in at least two charges. The average half-yearly consumption is estimated at about one hundred flasks of 74 lb. each, after allowing for the amount recovered in clearing up and distillation of the amalgam. The latter operation is performed at intervals of seven or fourteen days in the upper lengths of the sluice, and half-yearly in the lower parts.

The dressing or mechanical preparation of vein stuff containing gold is generally similar to that of other ores, except that the precious metal should be removed from the waste substances as quickly as possible, even although other minerals of value that are subsequently recovered may be present. This is usually done by amalgamation with mercury. In all cases the quartz or other vein stuff must be reduced to a very fine powder as a preliminary to further operations. This may be done in several ways, *e. g.*, either (1) by the Mexican crusher or *arrastra*, in which the grinding is effected upon a bed of stone, over which heavy blocks of stone attached to cross arms are dragged by the rotation of the arms about a central spindle, motion being furnished by mules or other power, or (2) by the Chilian mill or *trapiche*, also known as the edge-runner, where the grinding stones roll upon the floor, at the same time

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a Much valuable information on this subject will also be found in the *Fifth Annual Report of the United States Commissioners of Mining Statistics*, Washington, 1873, p. 390.

turning about a central upright,—contrivances which are mainly used for the preparation of silver ores ; but by far the largest proportion of the gold quartz of California and Australia is reduced by (3) the stamp mill, which is similar in principle to that used in Europe for the preparation of tin and other ores, but has received special modification in many details. Fig. 5 represents the ordinary Californian pattern of a stamp mill. The stamp is a cylindrical iron pestle faced with a chilled cast-iron shoe removable so that it can be renewed when necessary, attached to a round iron rod or lifter, the whole weighing from 600 to 800 lb. The lift is effected by cams acting on the under surface of tappets *a*, and formed by cylindrical boxes keyed on to the stems of the lifter about one-fourth of their length from the top. As, however, the cams, unlike those of European stamp mills, are placed to one side of the stamp, the latter is not only lifted but turned partly round on its own axis, whereby the shoes are worn down uniformly. The bed or mortar A is of cast-iron. The height of lift may be between 8 and 10 inches, and the number of blows from 30 to 90 per minute. The stuff, previously broken to about 2 inch lumps in a Blake's rock breaker, is fed in through the aperture *n* at the back of the "battery box," a constant supply of water being given from the channel *k*, and mercury in a finely-divided state is added at frequent intervals. The discharge of the comminuted material takes place through the aperture *d*, which is covered by a thin steel plate perforated with numerous slits about 1-50th inch broad, and 1-10th to $\frac{1}{8}$th inch long, a certain volume being discharged at every blow and carried forward by the flushing water over the apron or table in front *m*, covered by copper plates filled with mercury. Similar plates are often used to catch many particles of gold that may be thrown back, while the main operation is so conducted that the bulk of the gold may be reduced to the state of amalgam by bringing the two metals into intimate contact under the stamp head, and remain in the battery. The tables in front are laid at an incline of about 8 degrees, and are about 13 feet long ; they collect from 10 to 15 per cent of the whole gold ; a further quantity is recovered by leading the sands through a gutter about 16 inches broad and 120 feet long, also lined with amalgamated copper plates, after the pyritic and other heavy minerals have been separated by depositing in catch pits and other similar contivances

When the ore does not contain any considerable amount of free gold, mercury is not, as a rule, used in the battery. The pulverized stuff is received upon blanket tables or sluices. These are inclined boards covered with coarse woollen cloth or sacking. The heavier particles become entangled in the fibres of the cloth, while the lighter deposits are carried forward by the current. At intervals of a quarter to half an hour the surface of the blanket is completely covered, when it is removed, and its contents are washed off in a tub of water and reserved for further treatment. This consists of amalgamation, in a contrivance analogous to the Hungarian mill subsequently described, and subsequent treatment in pan amalgamators somewhat similar to the *arrastra* in character, but with grinding surfaces of iron instead of stone.

At Schemnitz, in Hungary, quartz vein stuff containing a little gold, partly free and partly associated with pyrites and galena, is, after stamping in mills similar to those described above, but without rotating stamps, passed through the so-called Hungarian gold mill, fig. 6. This consists of a cast-iron pan *a*, having a shallow cylindrical bottom *b*, holding 50lb of mercury, in which a wooden runner *c*, nearly of the same shape as the inside of the pan, and armed below with several projecting blades, is made to revolve by gearing wheels placed either above, or, as in the figure, below. The connexion of the runner with the driving shaft is effected by the three-armed crutch shown in plan at *e*, which sits on the square part of the shaft. By means of set screws analogous to those of a flour mill, the runner is adjusted at such a height that the knives just clear the surface of the mercury. The stuff from the stamps arrives by the gutter *f*, and, falling through the hole in the middle of the runner, is distributed over the mercury, when the gold subsides in virtue of its superior density, while the quartz and lighter materials

are guided by the blades to the circumference and are discharged at *g*, usually into a second similar mill, and sometimes to a third, placed at lower levels, and subsequently pass over blanket tables. The most advantageous speed is from 12 to 14 revolutions per minute. The action of this so-called mill is really more nearly analogous to that of a centrifugal pump, as no grinding action takes place in it. The amalgam is cleaned out about once a month. The average amount of gold collected from 50 tons of stuff stamped, is about 6 oz. in the mills, and in the subsequent dressing processes 1 lb of auriferous silver and 10 cwt. of lead. According to Rittinger, mercury that has been purified by distillation acts much more rapidly upon gold than such as has been saturated with the metal without losing its fluidity, although the amount that can be so dissolved is very small.

There are various forms of pan amalgamators of which space will not permit a description to be given. It may be stated, however, that experience of the great variety of pans that have from time to time been devised has led to the adoption of the more simple forms, in which the grinding is effected between horizontal flat surfaces instead of curved or conical bottoms, and in the pans now usually employed the flat grinding surfaces form an annular floor round a central cone through which a vertical shaft passes. The Knox pan fig. 7, may be considered to be fairly typical. It is of cast-iron, 4 feet in diameter and 14 inches deep. It has a false bottom to form a hollow annular space through which steam can be introduced. The centre of the yoke *d* attached to the muller *m*, is keyed to a vertical wrought-iron shaft S, 2 inches in diameter, which can be brought in connexion with the driving gear G. The blocks *r*, *r* are of wood. In working the pan 100 lb. of skimmings are introduced, and water added until the pulp will just adhere to a stick. After three hours' grinding the pulp is heated with steam. About 5 lb. of mercury are added for every charge, together with a cupful of equal parts of saltpetre and sal ammoniac. After three hours' further working, water with a little caustic lime is added, and the pulp is discharged first through an upper and then through a lower hole.

One of the greatest difficulties in the treatment of gold by amalgamation, and more particularly in the treatment of pyrites, arises from the so-called sickening or flouring of the mercury ; that is, the particles, losing their bright metallic surfaces, are no longer capable of coalescing with or taking up other metals. Of the numerous remedies proposed, the most efficacious is perhaps sodium amalgam. It appears that amalgamation is often impeded by the tarnish found on the surface of the gold when it is associated with sulphur, arsenic, bismuth, antimony, or tellurium. Wurtz (*a*) in America (1864) and Crookes in England (1865) made independently the discovery that, by the addition of a small quantity of sodium to the mercury, the operation is much facilitated. It is also stated that sodium prevents both the "sickening" and the "flouring" of the mercury which is produced by certain associated minerals. Cosmo Newberry has investigated with much care the action of certain metals in impeding amalgamation.(*b*) Wurtz recommends to amalgams, one containing 2 and the other 4 per cent of sodium, and in paactice 1 per cent or less of these is added to the mercury in the amalgamator. Crookes employs three kinds, which he calls A, B, and C, amalgams ; each contains 3 per cent of mercury, but the B variety has, in addition to the sodium, 20 per cent of zinc, and C is mixed with 10 per cent of zinc and 10 per cent of tin. The addition of cyanide of postssium has been suggested to assist the amalgamation and to prevent "flouring" but Skey (*c*) has shown that its use is attended with loss of gold.

Separation of Gold from the Amalgam.—The amalgam is first pressed in wetted canvas or buckskin in order to remove excess of mercury. According to Rittinger, mercury will dissolve from 0·05 to 0·08 per cent of native gold of standard 650 to 850 without loss of fluidity, the solubility of the

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a American Journal of Science and Arts, vol. xli., March, 1866.
b Ure's *Dictionary of Arts*, Supplement to 7th ed., p. 412.
c Transactions of the New Zealand Institute, 1876.

gold increasing with its fineness; and until the point of saturation is reached, no separation of solid amalgam is possible. Lumps of the solid amalgam, about 2 inches in diameter, are introduced into an iron vessel lined with a paste of fire-clay and wood ashes, and provided with an iron tube that dips below the surface of water. The distillation is then effected by heating, care being taken that the retort does not become visible red in daylight. The amalgam yields about 30 to 40 per cent of gold. In California the amalgam is retorted in cast-iron pans placed in cast-iron cylinders 11 inches in diameter, 4 feet 6 inches long, supported on brick work. The bullion left in the retorts is then melted in black-lead crucibles, with the addition of small quantities of suitable fluxes.

The extraction of gold from auriferous minerals by fusion, except as an incident in their treatment for other metals, is very rarely practised. It was at one time proposed to treat the concentrated black iron obtained in the Ural gold washings, which consists chiefly of magnetite, as an iron ore, by smelting it with charcoal for auriferous pig-iron, the latter metal possessing the property dissolving gold in considerable quantity. By subsequent treatment with sulphuric acid the gold could be recovered. Experiments on this point were made by Anossow in 1835, but they have never been followed in practice.

Gold in galena or other lead ores is invariably recovered in the refining or treatment of the lead and silver obtained. Pyritic ores containing copper are treated by methods analogous to those of the copper smelter. This is extensively done. In Colorado the pyritic ores containing gold and silver in association with copper are smelted in reverberatory furnaces for regulus, which, when desilverized by Ziervogel's method, leaves a residue containing 20 or 30 ounces of gold per ton. This is smelted with rich gold ores, notably those containing tellurium for white metal or regulus; and by a following process of partial reduction analogous to that of selecting in copper smelting, "bottoms" of impure copper are obtained in which practically all the gold is concentrated. By continuing the treatment of these in the ordinary way of refining, poling, and granulating, all the foreign matters other than gold, copper, and silver are removed, and by exposing the granulated metal to a high oxidizing heat for a considerable time, the copper may be completely oxidized while the precious metals are unaltered. Subsequent treatment with sulphuric acid renders the copper soluble in water as sulphate, and the final residue contains only gold and silver, which is parted or refined in the ordinary way. This method of separating gold from copper, by converting the latter into oxide and sulphate, is also used at Oker in the Harz.

Chlorination Process.—Plattner suggested that the residues from certain mines at Reichenstein, in Silesia, should be treated with chlorine after the arsenical products had been extracted by roasting. The process, which depends upon the fact that chlorine acts rapidly upon gold, but does not attack ferric oxide, is now adopted in Grass Valley, California, where the waste minerals, principally pyrites from tailings have been worked for a considerable time by amalgamation. The roasting is conducted at a low temperature in some form of reverberatory furnace. Salt is added in the roasting to convert all the metals present, except iron, into chlorides. The auric chloride is, however, decomposed at the elevated temperature into finely-divided metallic gold, which is then readily attacked by the chlorine gas. The roasted mineral, slightly moistened, is next introduced into a wooden vat, pitched inside, and furnished with a double bottom, as is shown in fig. 8. Chlorine is led from a suitable generator beneath the false bottom, and rises through the moistened ore, resting on a bed of broken quartz below the false bottom, converting the gold into a soluble chloride, which is afterwards removed by washing with water. The precious metal is then precipitated as metallic gold by sulphate of iron. The process has been greatly improved in America by Kustel, Deetken, and Hoffmann; with proper care it is a very perfect one, and yields 97 per cent of the gold originally present in the ore. It is stated not to cost more in California than 50s. a ton. Any silver originally present in the ore is of course converted into chloride of silver and remains with the residue, from which it may be extracted by the solvent action of brine or by amalgamation.

GOLD IN CEYLON.

(From the *Ceylon Observer*, April 8, 1881.)

Extracts from a Paper read at the Royal Asiatic Society, Ceylon Branch, by Mr. A. C. Dixon, on Gold in Ceylon. The following are the main facts :—

There is a great similarity between the hill regions of Ceylon and the S. E. Wynaad district at the N. W. base of the Nilgiris which has recently become so prominent an account of its auriferous reefs. As to the probable age of these districts we are uncertain, but there can be no doubt that the two regions are contemporaneous, consisting of granitoid schists or *gneissoid* rocks—that they are highly metamorphosed, and that quartz reefs form a conspicuous feature.

The reefs are often white, occasionally somewhat brecciated and not unfrequently bound together by *haematite* or *limonite*.

Although the strike of the rock is peculiar in the Nilgiris, E. N. E., yet the auriferous reefs run N. N. W. corresponding with the gneiss a little further to the north. The general run of the rocks is N. to N. W. As on the Wynaad we have an absence of intrusive rock. No dykes, porphyritic masses or basalts. It has been observed that the auriferous belts are richest where micaceous and chloratic rocks occur. Strange to say in the cuttings of the railway into our hill district and the various cuttings on the public roads no prominent reefs have been crossed ; probably one or more may be met with in the extension of the railway from Nawalapitiya to Nanuoya. In several parts, the country is traversed by large persistent reefs of quartz with numerous narrow seams and veins diverging from them and often traceable into decomposed lithomargic earth. Some good examples of these are to be found in the Balangoda, Pussellawa, Ramboda and Dolosbage districts.

The character of the vegetation in prospecting for gold is of great assistance in Australia, where each formation is characterized by distinct forms of vegetation, but in Ceylon we have no guidance, at the mountainous zone is but one formation. Gold occurs in three chief forms. 1, As scattered grains or nuggets on alluvial deposits, having been set free by natural causes from its matrix. 2, In grains and leaves on numerous veins, chiefly quartz. Still in the matrix but not with other metals : this is called *free* gold. 3, Associated (but not chemically combined) with numerous other metallic compounds, such as arsenides, sulphides, &c., generally classed under the term *pyrites*, found on veins of quartz and other rocks.

In the first form I have met with it in the alluvium of the Deduruoya beyond Kurunegala. The particles were exceedingly small and other metallic matters were not uncommon. This must have come from some quartz reef further up in the hills. Its occurrence on this river is referred to in the "Kadajurepattu."

A second instance of its occurrence in this form was in the Galle district, where a small nugget was taken from the alluvium accumulated in one of the ravines ; it weighed over six grains, and was associated with fragments of gems, such as sapphire, garnet, chrysoberyl, tourmaline, &c., as well as of sulphides of some rare metals. This deposit was due to disintegration from the matrix in which they occurred originally. I followed up the ravine to its head with the expectation of finding quartz reef from which the gold must have been dislodged, and found two small reefs crossing the ravine. I took specimens from these and found traces of gold, but not in sufficient quantity to warrant its being worked. I have had further specimens from these reefs of a much better character.

In the second form it occurs in the Ramboda district, Central Province, where several remarkable reefs strike across the valleys.

In the third form it occurs in the pyrites of the gem-pits in the Ratnapura-Rakwana districts, but only in very small quantity.

From the little I have seen, it is my opinion that considerable quantities will yet be brought to light.

"GOLD IN CEYLON."

(From the *Ceylon Observer*, May 11, 1881.)

We may have to consider the propriety of taking a small contract for the supply of quartz to the breakwater if the present liberal receipt of rock-specimens from would-be gold-seekers continues! As a rule however the pieces which reach us do not afford a fair criterion of the quartz reefs, the specimens being taken from the surface. Among the acknowledgments we have to make are the following :—

A correspondent writes :—"Agra Patanas, May 1.—I herewith send per this post a sample of what, I suppose, is either metallic matter or gold amalgam, *i.e.* a mixture of gold and quicksilver, found in the bank of a stream. There are traces of it all through, but it is confined more towards the source, where marks of working still exist. The Sinhalese must have had some object in view some years back or they would n't have laboured hereabouts. Please give me your candid opinion."

There is no gold in what our correspondent sends : the shining particles were pronounced by Mr. Macdonald Cameron to be all mica.

Another correspondent writes :—"Wallaha, May 2nd.—I have sent off to-day from here a small box containing a piece of quartz. Two pieces (small ones) wrapped up in paper have come off the same piece as sent, and seemto show decided signs of gold to the naked eye. Trusting it may turn out well."

We regret to say again that Mr. Macdonald Cameron pronounced against the chance of gold being found in this block of quartz: it is pyritous, the outer portion being marked by feldspar, but it is impossible to judge from the specimen sent of what the quartz reef proper may be like. The small piece sent is more promising, but it is iron pyrites rather than gold that glistens. Specimens of quartz to afford a fair idea of the quality of a reef should be taken from a depth of 8 or 10 feet, but planters would require to understand a little how to explore their ravines for the outcrop of a reef (not so much of a bed) of quartz, and then to note accurately its dip and have it traced before proceeding to dig or blast for a sample.

A Maskeliya correspondent writes :—

"I have a reef of quartz which, I would fain hope, is auriferous, though I fear it is more likely to be ferruginous! The quartz is dotted through with dark colored particles, which glitter when rubbed down with powder, a few of which I have pricked out, and enclose for your inspection and kind opinion. With thanks in anticipation."

Again we are sorry to say that the report is not favourable, although the sample is far too small, and from too near the surface, to enable a proper decision to be arrived at. The particles are micaceous. From Haputale we have :—

"Per to-day's post I send you two samples, one of quartz and one of sand. Do either of them contain gold, as I notice some yellow substance among them? I picked them up in one of the ravines on this estate."

These consist chiefly of mica. Again we have the following :—

"5th May 1881.

"Dear Sir,—Evidently Ceylon must be simply teeming with gold, for I hear that the Sinhalese say Balangoda is the district famous in olden times for that precious metal. By to-day's post I send you a sample of what I believe to be iron-pyrites, which is, I 'm told, a sure indication of gold. Is such the case?—Yours faithfully, W."

Our correspondent is correct in describing the sample as iron pyrites, which is common where there is but little of gold. At the same time the Balangoda, Ratnapura and Rakwana districts have long been reported to be rich in gold as well as gems. Of gold specimens found near Ratnapura, more anon. Meantime perhaps the most promising specimens of quartz we have received so far are from Kinrara estate, Matale. Without being auriferous these are more

like what experts wish to see in looking out for a promising quartz reef. But it is not likely planters can prospect to advantage without professional guidance or instruction. We are reprinting as fast as possible all the information given in the *Observer* during 1854 and 1869 on the subject, including a practical paper on "How to Find Gold," and the article on "Gold" from the latest number of the "Encyclopædia Britannica." All this will be a help to planting prospectors. We have also been enabled to use the reports of Mr. Saunders, when Assistant Agent at Ratnapura, in whose time gold dust and nuggets were found in some considerable quantity. Mr. Wm. Murray, an old Australian digger, then declared that the evidences were most satisfactory; *while Mr. Brough Smyth, to whom some of the gold was referred for report, expressed the opinion that the reef, the matrix, could not be far off, the gold having the appearance of not having travelled far.* The Government of the day, however, threw cold water on prospecting proposals, and nothing was done. We shall publish Mr. Saunders' interesting Reports in the *Observer*, and the Government Agent has also been good enough to leave with us a sample of the gold found on that occasion which can be seen at the *Observer* office:—a veritable proof that there is "GOLD IN CEYLON."

THE DIAMOND DRILL AND THE EARTH SCOOP.

We have received from Melbourne papers referring to these two labour-saving appliances. The paper referring to the diamond drill is printed in the form of a poster, being addressed "to the mining community" by the Bendigo School of Mines and Industries. It contains sketch sections, and patterns of diamond drills, with accompanying letterpress. Figure 1 represents a bore sunk in the Bendigo district to the depth of 825 feet, passing through alternate strata of sandstone and quartz, gold having been struck at 390, 512, 606, and 706 feet. The result of this has been to send up the shares of the Company (G. G. Consolidated) from 6d to 8s 3d. The drill employed was one which could operate only from the surface: if it could have been taken into the mine to work from the lower levels the results would have been much more important. This is being done in America, and figure 2 gives an illustration of such workings at Silver Islet, Michigan, where the drill, occupying only 7 feet by 6 feet, was lowered to the eighth level (488 feet) and experimental holes were bored in all directions, thus yielding information as to the contents of the mine which could not otherwise have been obtained without years of labour. The machine used in this case bored three thousand feet in six months, the only repairs needed at the end of that time being trifling. Well therefore may Mr. Bayne, the President of the Bendigo School of Mines, say:—

"As a prospecting tool then, the Diamond Drill is quite unique, and accomplishes results that can be obtained by no other known process. It should be remembered at the same time that it is a scientific instrument and not a divining rod. It must be used with discretion, and its indications read intelligently. It does not point by some inscrutable agency to payable reefs, but it tells us with great certainty and with remarkable expedition whether we shall come to auriferous quartz if we dig down or along a certain direction within the 2,000 feet or more. A negative answer saves the trouble and expense of sinking or driving in that direction, and we have then only to put further questions by varying the direction of the line of search. Their use enables a larger amount of work to be performed and thereby increases the demand for labour, and it is to be noted that in the States where these drills find such favour, the price of labour reaches from 10s. to 15s. a day, showing that the drill recommends itself as much to the miner as to his employer. At the Great Northern Company, Stawell, Victoria, where one of these underground drills is now at work, in 60 shifts of 8 hours each, or 480 hours, between April 27th, and July 5th, 1880, it has bored through 483 feet 3 inches, commencing at a depth of 800 feet. This is looked

upon as very satisfactory considering the hardness of the stone, a sample of which may be seen at the School of Mines, Sandhurst."

An extract from the *Scientific American* of 28th Feb. 1880 states that "Mr. A. J. Severance, of San Francisco, says that the Diamond Drill has played a very important part in developing the mineral wealth of the West. The first great treasure-house which these drills opened up was that known as the Consolidated Virginia, and the California Bonanzas, which have yielded Twenty-two million two hundred and ninety one thousand pounds sterling, of which the stock-brokers have received Fifteen million four hundred and sixteen thousand pounds sterling, in dividends. One of the Owners of the mine told Mr. Severance that the Diamond Drill had realised for him One million pounds sterling. All the principal Comstock mines, and many of the largest mining properties located in California and Nevada, use these drills. They are also extensively used in Colorado, have pushed their way to most of the Territories, have been introduced and operated in New Mexico, Old Mexico and Australia. The Japanese Government has also been supplied with them. Mr. Severance enjoys the distinction of having perfected the Diamond Drill, and of proving its utility by running a horizontal hole (then regarded an impossibility) eight hundred feet, taking out a complete cylindrical core, and showing the strata of every inch of rock passed through. This was done in Vermont. Soon after he introduced the drill upon the Pacific Coast, with the results already noted."

Figures 3 and 4 show the tunnel and mining drill and the open cut and quarry drlll respectively. The former when set up weighs about 300 lb., the size of the bit is $1\frac{1}{2}$ in. diameter, and the price £261; the latter weighs 250 lb., size of bit 1 to $1\frac{3}{4}$ in. diameter, price £209. These drills might be useful in Ceylon not only for gold prospecting but perhaps for sinking wells in the drier parts of the island. This brings us to the "patent wheel earth scoop," manufactured by Messrs. Robinson & Sons of Melbourne, for making dams and tanks to retain rain water. The prospectus states that "It is as simple as it is possible to be made. It is very strong, being made nearly wholly of wrought iron, so that there is little chance of it breaking. The draught is only half that required for a skid scoop of equal size, besides being much handier and easier for the man (who can both drive the team and work the scoop,) it does the work in far less time, as being on wheels it enables the team to travel much faster than with askid scoop. The prices given range from £14 upwards. The principle of the scoop appears to be the some as that of the Elder steam scoop, regarding which we quoted a paragraph from the *Sydney Mail* in our issue of 26th February last.

GOLD IN CEYLON.

FURTHER OFFICIAL REPORTS ON THE EXPLORATION AND DIGGING IN 1854.

No. 123. Colombo, 14th March, 1854.

The Hon'ble the Colonial Secretary, Colombo.

SIR,—I have the honor to report for the information of His Excellency the Governor, that being on a visit to the spot to which the recent discovery of gold by some sailors has drawn attention, I am enabled from a personal inspection to confirm the fact of the discovery.

The situation of the place of operations is the rocky bed of the Maha Oya about five miles north of Wewcldeniya, between the 31st and 32nd milestones on the Kandy road, and about an equal distance from Giriole and Ambepusse, and adjacent to the Kale Gampola Udugaha Corle of the Kurunegalla district and the Uddagaha Pattoo of the Hapitigam Corle of the district of Colombo.

The Maha Oya, which has a north-westerly direction up to this point, takes here a nearly direct northerly sweep, and during the dry season exposes a much broader expanse of bed than at any other part immediately above or below it.

The broken surface, on the eastern side principally, is occupied with a mass of débris probably washed from either bank, which is found to give cover to other disintegrating masses, which may belong either to the rock overlaid or to the superincumbent deposits.

The resemblance of this bank to places in which some of the party of sailors had witnessed the successful search for gold elsewhere, appears to have attracted them and to have induced them to conduct their experiments here with results which have in some degree served to unsettle the public mind.

From all I have been able to gather, the quantity of gold collected from the date of the first experiment on the 2nd instant, does not exceed one ounce, and probably does not amount to so much.

The washing of about eighteen buckets of soil, weighing about 8 cwts. in my presence, only yielded half a grain of gold, and I find in a passage in Dr. Ure's Dictionary of Arts that veins which yield 10 or 11 grains of gold in a cwt. would scarcely defray the expense of working.

The nature of the soil, however, is such as is generally known to be gold-yielding, and though I am not sanguine that the precious metal will be found in sufficient abundance to reward the exploitation, I think every encouragement is due to such persons as are disposed to prosecute the search, and have accordingly just allowed a second party of sailors to choose for themselves another place of trial, the traces of gold according to the report of the first explorers not being confined to this locality, but being met with at other parts of the Maha Oya, of which a bar about 1½ miles lower down the stream, and another ¾ of a mile immediately above the present occupation have been mentioned as instances.

Dr. Ure states that Reaumur had remarked that the sand which more immediately accompanies the gold spangle in most rivers, and more particularly in the Rhine and Rhone was composed, like that of Ceylon and Expailly, of black protoxide of iron and small grains of rubies, corundum, hyacynth, &c.

The correctness of this observation with respect to Ceylon is borne out by the appearances presented during the process of washing here, the residuum, after the separation of the coarser components of the soil being invariably a black sand with an admixture of minute gems and spangles of gold.

Having assisted the sailors in constructing an embankment for the purpose of facilitating their operations by obtaining a flow of water at a higher level than they can at present command,

I shall await the conclusion of an experiment made under more favourable circumstances to communicate again with Government.

I have, &c.,

(Signed) C. P. Layard, Govt. Agent.

No. 124. Colombo, 15th March, 1854.

Sir,—With reference to my letter of the 14th instant from Talagama in the Hapitigam Korle, and finding that the permission granted by me to certain sailors to dig for gold in anticipation of the authority of Government would have been inconsistent with His Excellency's minute of the same date which I had not then seen, I have the satisfaction to report that that permission was not availed of by the parties to whom it was granted.

I have, &c.,

(Signed) C. P. Layard, Govt. Agent.

Further Report on the Gold Discovery of 1868.

No. 818. Government Agent's Office, Colombo, 18th Decr., 1868.

Sir,—In submitting the accompanying copy of a letter from my Assistant at Ratnapura, dated the 16th instant, I have the honor to recommend

a compliance with Mr. Home's request to the extent that Government should procure for him under the provisions of the Ordinance No. 2 of 1863 any private land which he is unable by private arrangement to acquire for the purposes of his research, on his making full payment of its value.

With respect to the reward to be offered for the discovery of gold in remunerating quantities, I think that as well as the condition on which the right of working gold fields should be conceded to Mr. Home and others in the event of their being found to exist, may be a matter for after consideration.

I am of opinion that the exclusive privilege of searching for gold within a radius of two miles from the point where the traces of the precious metal have been already found, cannot be reasonably conceded.

I have, &c.,

(Signed) C. P. LAYARD. Govt. Agent.

The Hon'ble the Colonial Secretary.

GEOLOGY AND MINERALOGY OF CEYLON.

(*From Pridham's "Ceylon."*)

In Ceylon there is not that order and succession of rocks to be found as in England and other parts of Europe. Uniformity of formation is the distinguishing characteristic of the geological character of the island, and with but few and partial exceptions, such as at Jaffna and the contiguous islets, and here and there along the shore about high water mark, it may be said to consist of primitive rock, and unconnected with any other class of rock, exclusive of those of very recent formation.

Another remarkable geological fact is, that though the varieties of primitive rock are extremely numerous, and indeed almost infinite : the species are very few, and seldom well defined. The most prevailing species are granite or gneiss ; the less frequent are quartz-rock, hornblende rock, and dolomite rock, which may be classed under the head of imbedded minerals.

The varieties of granite and gneiss are endless, passing often from one into another, and at times losing their character by the transition, and assuming appearances for which, in small masses, there would be a difficulty in finding appropriate names. These mutations and remarkable variations are traceable chiefly to composition, the proportions of the elements, the excess or deficiency of one or more, or on the addition of new ingredients. Nor should mechanical structure, variation in which, though hardly palpable in reference to causes, has an evident effect in regulating appearances, be omitted. Regular granite is rare ; where found it is generally of a grey colour and fine grained. Graphic granite is still rarer. The quartz, where it is found, is black or grey rock crystal, and the felspar highly crystalline and of a bright flesh colour. The quartz envelopes the felspar in very thin hexagonal or triagonal cases, so that nothing can more vary in appearance than the longitudinal and transverse fracture of the rock. Petrifactions of wood, combining quartz and felspar, have been occasionally found in the interior. This is a mineralogical novelty, the latter substance never having been found in petrifactions of a similar nature.

Moonstone has also been found embodied in porphyric rocks in large masses, and is more beautiful than moonstone hitherto dug from rocks of decomposed white clay. Sienite is uncommon. It occurs in the interior, rather forming a part of rocks of a different kind than in great mountain masses.

Well formed gneiss is more abundant than granite. Its peculiar structure may be seen in many places, but no where so clearly as at Amanapoora in the Central Province, where it consists of white felspar and quartz in a finely crystalline state, with layers of black mica, containing, disseminated through it, numerous crystals of a light-coloured garnet. Both the granite and gneiss are very much qualified by an excess or deficiency of one or other of the ingredients. When quartz abounds in a fine granular state, the rock often looks very like sandstone ; of this there is an instance in the vicinity of Kandy. When felspar or adularia abound, the rock acquires a new external character : this variety is common. In a few places the rock con-

tains so much of these minerals that it might be correctly called adularia, or felspar rock. When mica prevails in gneiss, which in Ceylon is very rare, it acquires not only the appearance, but very much the structure of mica slate. The instances of change of appearance in the granitic varieties from the presence of unusual ingredients, are neither few in number nor unfrequent in occurrence.

The more limited varieties of primitive rock, as quartz, hornblende, and dolomite rock, seldom occur in the form of mountain masses. Quartz is found in some places so abundantly in granite rocks as even to rival mountain masses. It is generally quite bare, and stands erect like denuded veins. From its precipitousness it often exhibits the appearance of buildings in ruins. The quartz is in general milk-white, translucent, full of rents, and so very friable as to resemble unannealed glass. Pure hornblende rock and primitive greenstone are not uncommon, and though they constitute no entire mountain, form a part of many, particularly of Samanala and the Kandyan mountains.

Dolomite rock is almost entirely confined to the interior, where it is found in veins and imbedded, and sometimes constitutes low hills. The varieties of dolomite rock are almost as numerous as those of granite. When purest it is snow-white, generally crystalline, composed of rhombs that are easily separated by a blow, but rarely finely granular. When highly crystalline it is composed of about 56 of carbonate of magnesia, 36·9 carbonate of lime, 4·1 alumina, 1 silica, 2 water. A very fine granular kind is found, but it is so uncommon, that it was appropriated under the Kandyan dynasty to the sole use of the king. The great variety of this rock arises both from the proportion of carbonate of lime and of magnesia being seldom the same, and from the commixture of other minerals. The varieties most frequent are mixtures of dolomite with felspar and mica, and even quartz. It is from the purer kinds of dolomite rock that all the lime employed in building in the interior is procured. The presence of magnesia injures its qualities as a cement; but though inferior in this repect to the lime from shell and coral, it answers sufficiently well for ordinary uses.

In external character and general structure, the varieties of primitive rock exhibit fewer marked differences than might have been expected. The masses that are exposed, are generally rounded, seldom rising to craggy points or appearing in grotesque shapes. The nature of the rock may often be surmised, from its external appearance, but generally cannot be precisely determined but by an examination of a recently fractured surface. In structure the granitic varieties most commonly exhibit an appearance of stratification, but is not easy to decide positively whether this appearance is to be attributed to the mass being composed of strata or of large laminæ or layers. Some great masses of insulated rock, several hundred feet in height, exhibit incontrovertible proofs of this structure. In these the same layer may be seen extending over the rock, like the coat of an onion, and which if but partially exposed, might be adduced as a strong proof of stratification, and if examined in different places on the top and at each side, might be deemed an extraordinary instance of the dip of the strata in opposite directions. With this hypothesis of the structure of the rocks, the appearance of stratification in all the granitic varieties may be easily reconciled.

Rocks of recent formation are of two kinds, limestone and sandstone. The first is said to be confined to the province of Jaffna, the most productive and populous district of Ceylon, which is an extended level plain without a single hill or valley, and contains numerous decomposed shells, and other marine productions; it is generally grey or light brown, very fine grained and compact, and breaks with a conchoidal fracture. It is generally nearly a pure carbonate of lime, affording but slight traces of the presence of vegetable or animal matter, and containing a little water. Where it occurs, the whole of the country is similar, and elevated but a few feet above the surface of the sea, by which it was once probably covered. The recession of the sea from this district is even now going on, many natives recollecting the waves covering spots now far above high-water mark. It is proved also from the fact of coral rock being found mixed with the limestone rock several miles from

the sea. Minute inquiry on the spot might elicit some valuable information on the formation of this rock, which is still probably extending in the shallows of the adjoining seas, and along the coasts of Jaffnapatam. Its formation may possibly be connected with coral, which is so abundant in the narrow seas between Ceylon and the Indian Peninsula, that most, if not all, of the islets in the strait are composed of it, and the gradual increase of coralline in the waters near these shores proves the natural and steady encroachment of the land. The only difficulty is, to find the cause of the solution of calcareous matter in some places, and its precipitation in others adjoining.

Sandstone, the other rock belonging to the recent formation, may be considered to surround the island with an almost uninterrupted chain. It exhibits in every part the same general character, and is found under the same circumstances, in horizontal beds along the shore, chiefly between high and low water mark, which in Ceylon, where the tide rises only about three feet in perpendicular height, is a very limited extent. In shallow water, it may extend perhaps farther into the sea. Towards the land, it does not extend beyond the beach. A remarkable instance of this is found on the north side of the Kalné-ganga. In width the bed varies from a few to fifty or even a hundred feet. Towards the sea, it presents a bold face, above twelve feet deep, perpendicular like a wall, over which the waves break, and which, when the sea runs high, as it does on this shore, a great part of the year, is completely under water. On the other side, towards the land, the rock commonly terminates in sand, the beach generally rising above it. This bed is in most places distinctly stratified, and where the strata are not deranged by fractures and subsidences, they are quite horizontal. The appearance of the rock is not uniform : its principal varieties are a yellowish-grey sandstone, another almost black, and a third of the first kind, but containing nodules of the latter. These varieties occur in the same stratum, and a vertical section often exhibits successive layers of the two first kinds. They all consist of sand agglutinated by carbonate of lime, which, from its texture, appears to have been deposited from water. Thus the stone crumbles to pieces, and is reduced to sand when heated before the blow-pipe or immersed in an acid. The proportion of carbonate of lime is variable, being from 26·5 to 11 per cent. The larger the proportion, the harder is the sandstone ; thus the last-mentioned is soft and taken from a depth in an incipient state of formation, while the former is taken from the surface, is completely formed and extremely hard. Irrespectively of the proportion of carbonate of lime, the sand of which the stone is formed, is of different kinds. The sand of the light-coloured variety is chiefly silicious, consisting of fine water-worn particles of quartz, like the sand of the shore, and like it, it occasionally contains shells and pebbles. The sand of the variety nearly black, is a mixture of silicious particles, and of particles of iron glance becoming magnetic by wasting. It is extremely hard, the iron no doubt acting the part of a cement, as well as the carbonate of lime.

The question of the formation of the sandstone is involved in much of the same obscurity as that of the limestone of Jaffnapatam, and the same conjectures might be offered respecting the probable cause of the deposit of the calcareous cement. This instance of the formation of rock from the dissolved and disintegrated materials of old rocks is not peculiar to Ceylon, as it is quite as common as those of decomposition itself. Both the limestone and sandstone of this recent formation, may become very useful. Very good lime may be made of the former, and serviceable millstones, perhaps of the latter, if it can be found, as is very probable, of a coarse quality. For architectural purposes both stones are well adapted, more especially the sandstone for great public works, as it may be wrought at little expense, and when the wind blows off the land, may be easily shipped.

Mineralogy.

The mineralogy of Ceylon, is, in some respects, remarkable and curious. The island is remarkable for its richness in gems, and, so far as has yet been ascertained, for its comparative poverty in the useful metals. It is remarkable also for the number of rare minerals that it affords, and for the small

variety of the ordinary species; thus in its mineralogical character, it accorded with the taste of its late native rulers, who were more prone to display than any work of utility, to pomp than profit. Its mineral productions may be classed under two heads, those attached to granitic, which constitute the greater part, and those pertaining to dolomite rock. The only metallic ores that can be hitherto said to be found in any quantity deserving of notice, are of iron and manganese. Iron in different forms is pretty generally diffused, and somewhat abundant. Iron pyrites, magnetic iron ore, specular iron ore, red hematite, bog-iron ore, and earthy blue phosphate of iron are all found. Red hematite and bog-iron ore are more common than the other species. It is from these ores that the natives extract the metal. With the exception of iron pyrites, magnetic ironstone and the blue phosphate, the species of iron occur so frequently in granitic rock or its detritus, as not to require notice. The first, iron pyrites, is found at Ratnapura, disseminated through a grey felspar rock, and in veins of quartz at Mount Lavinia on the sea shore. Magnetic iron ore is found in masses, imbedded in gneiss in the vicinity of Kandy and in granitic rocks in Wellassa and Trincomalee. The earthy blue phosphate of iron is procurable from a marshy ground near Colombo, and from a bed of bog-iron ore near Kandy. It is said to be used by the natives as a pigment.

It is to be observed *that no great bed, and that no considerable vein of iron ore has yet been found in Ceylon*; though we must remark that a full half* of the island is comparatively speaking a terra incognita to the Europeans in Ceylon capable of investigating it. No foundry on an extensive scale could then, judging from present appearances, be established with success. To the natives it may possibly be worth while to collect scattered masses of ore for their little furnaces, but unless an extensive bed or vein of ore be found, the attempt to establish a foundery would be idle. Iron is melted by the natives in crucibles, over a fire which is blown with two bellows. The scoria is separated from it with tongs made expressly for the purpose, and the melted mass is poured into a mould of clay, after which it is purified further, and forged for smaller uses. But one ore of manganese, the grey or the black oxide, is yet known in Ceylon, and that occurs in parts of Saffragam and Upper Ouva. Like most of the ores of iron it occurs finely disseminated and imbedded in small masses in granitic rock; some specimens are pure, and in some places a considerable quantity might be collected. Hitherto it has been applied to no useful purpose, nor from its locale and dispersed state is it likely to be exported with profit.

From the nature of the rocks, other metals might have been expected in Ceylon, says a learned geologist. who mentions that he has sought in vain among the mountains for tin, copper, and lead. All three, however, are reported to exist by persons who have themselves discovered them, and quicksilver and plumbago (kalu mirinan, *Singh.*) which of late years has been largely exported to England, may be added to the list. Gold and mercury, which are said to occur native in Ceylon, according to this writer are rarely found, but small lumps of the former have been at times met with. "Did any," he continues, "of the common, and what is more, of the precious metals occur in Ceylon it would have been known long ago; for the natives are inquisitive and curious, and being in the habit of searching for gems, and collecting everything that glitters, or that is in the least likely to sell, even bits of iron pyrites and ores of iron, it would be very extraordinary were they to pass unnoticed substances more attractive, with the value of which they are well acquainted." I may cursorily observe that this remark

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* Coal is said to have been discovered in the island by the Dutch; but from the abundance of wood, and charcoal being the only fuel used by the native cooks, no notice was taken of the discovery, so that its habitat is now unknown. The discovery of coal would now be considered one of the greatest acquisitions of which this favoured land could boast. It is not at all improbable that it exists in parts of the scarcely explored districts in the north, where I venture to predict the mineral wealth of Ceylon will be found to lie.

is rather applicable to the natives of the southern, than any of the other provinces of Ceylon, and that the opposite conclusion of another learned geologist, embodied in the note,* is nearer the truth. Dr. Davy's erroneous conclusion on these points must have arisen from the imperfect opportunities at his disposal for the survey of the whole island, not more than one-third of which he ever visited, and not from any want of sagacity in observing, or ardour in pursuing the various branches of natural science. Stahlstein, or crystallized pyrites, impregnated with a little copper, is used by the Singhalese for making buttons.

Most of the gems for which Ceylon is celebrated, occur in granitic rock; for though found in alluvial soil and the beds of rivers, their true source may be conjectured from the nature of the surrounding rocks and the quality of the sand and alluvium in which they are found. The minerals pertaining to this rock are of the quartz family, quartz, iron flint, chalcedony and hyalite. Ceylon affords all the varieties of quartz, as rock-crystal, amethyst, rose-quartz, cat's-eye, and prase. Rock-crystal occurs in abundance, both massive and crystallized, of various colours, good quality and in large masses. Its localities do not need noticing. Buttons are made of it. The black-crystal is of a shining fracture, and falls into slate-like shivers, which are transparent at the edges. It possesses electrical properties. The natives use it instead of glass for the lenses of spectacles; they employ it too for ornamental purposes and statuary. In the Mahawihara, in Kandy, there is a small well-executed figure of Buddha of this stone. Amethyst (Skuandi, *Singh.*) also is pretty abundant; very beautiful specimens of this mineral are found in the alluvium derived from the decomposition of gneiss and granitic rock in Saffragam and the Seven Korles. The largest specimens are cut for buttons, and the smaller for a smaller-sized button. The more saturated the colour is in them, the riper they are. They were probably once in a fluid state, and previous to their crystallization were tinged with a violet colour, which incorporated itself with a part or else with the whole of the fluid. It is of a purple violet colour, differing much in the degrees in which they are coloured. Some are so saturated as to appear almost black. They seldom reach the size of a walnut; the larger they are the paler, and less esteemed. Crystals of it, containing apparently two distinct drops of water, have been found. Rose-quartz, which is pretty common, is often found in the same place as amethyst.

Ceylon produces the finest cat's-eyes (Wairodi, *Singh.*) in the world; indeed, the only kind that is highly esteemed and that brings a high price. The best specimens of this singular mineral have been found in the granitic alluvium of Saffragam and Matura. It is a hard stone, approaching more or less to white or green, semi-diaphanous, with a streak of the breadth of a line in the middle, whiter than the stone itself, and throws its light to the side that it is turned. It is a pseudo-opal, averaging the size of a hazel nut. Prase is a variety of quartz that seldom occurs in the island. The second species, iron-flint, is not uncommon in the Central Province, Saffragam, and Lower Ouva. Some varieties of it much resemble hornstone. The third species, chalcedony, undoubtedly exists somewhere in the mountains of the interior, as fragments of it have been observed in the possession of the natives. The fourth species, hyalite, is extremely rare, being met with only in a nitre cave in Doombera, partially encrusting a granitic rock.

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* The sciences of geology, mineralogy, &c. in all their branches are but imperfectly understood by the natives, notwithstanding Ceylon is the depository of such an extensive variety of specimens. Their attention seems never to have extended much beyond the valuable gems and the common ores. As to a thousand other objects, both on the surface of the earth and imbedded in the hidden substrata of nature, so interesting to men of science, they have allowed them an almost undisturbed repose, never having exerted themselves either to quarry out a knowledge of their latent properties or ascertain their intrinsic worth.

Belonging to the schorl family are two species, the topaz and schorl (Purperagan, *Singh.*). The former is generally known as the white or water sapphire. It is commonly white, or bluish, or yellowish white; much water-worn, and perfect crystals of it are very rare. It occurs in many places in the alluvium of granitic rock, about the size of a large nut, and is clearer than white crystal. Schorl is not abundant; common schorl is perhaps an exception, it is to be seen in many places in the granitic rocks, and in places in Lower Ouva, mixed with quartz and felspar, it constitutes a rock of considerable magnitude. Tourmaline is rare, and the common varieties of green (patje turemali), a name given both to chrysolites with tetraedal prisms, and even sometimes to the chrysoprasi. It is often opaque, and various shades, bordering on yellow, blue, and black, are classed under it; honey yellow (kaneke turemali), is a topaz of a greenish yellow in appearance, resembling amber; some are more saturated and ripe, almost of an orange colour. Red (pana turemali), is a quartz; when laid on a table it appears opaque; held to the light it has a pale red hue. They vary in size from a grain of rice to a pea. They are seldom crystallized, and most of them are worn smooth and polished from the action of the water. Blue (neelà turemali), is a quartz; white (sudu turemali), is a topaz of a pale yellow, called the Matura diamond. It is not perfectly transparent; for this reason, it is often calcined in the fire, which has an effect on the colour but the stone is made clearer. It is then enveloped in fine lime and burned with rice chaff. It is cut for setting in rings, &c. With the exception of the last, most of these are of an indifferent quality, and their locality is unknown. Some writers have maintained that both the emerald and beryl are found in Ceylon. The former, says Davy, is certainly not found, and there is much doubt as to the existence of the latter, most of those offered for sale being imported; and those said to be found in the island being improperly so, as affording an excuse for a higher price than that asked for those of the continent, which are contemptuously called "coast stones."

Of the garnet family three species occur in gneiss or granitic rock, viz., the garnet, pyrope, and cinnamon stone. The common garnet is abundantly disseminated through gneiss in almost every part of the country. Its crystals are in general indistinct, small, contain a large proportion of iron, and are very apt to decompose. The best and most perfect crystals of this mineral are in quartz rock. The precious garnet occurs but in few places, and not in first-rate quality. It is contained in hornblende rock at Trincomalee.

Cinnamon stone, though an abundant mineral in this island, to which it exclusively pertains, is found only in a few places, and chiefly in the Matura district. It occurs in granitic alluvium in small irregularly shaped pieces, and in large masses of several pounds weight. Near Belligam a large detached rock is partly composed of this mineral; the other ingredients of the rock are felspar, tablespar, quartz, hornblende, and graphite. "The thick jungle," says Dr. Davy, "round the spot where this interesting rock stands, prevents a minute examination of the neighbouring country;" but his opinion seems to be that this rock had been detached from a vein or bed included in gneiss or granitic rock in the hill above. Another mineral of a doubtful nature, disseminated in small masses, occurs in many places, as at Colombo, Mount Lavinia, &c. It is semi-transparent, and never crystallized, and has the fracture and lustre of cinnamon-stone. It certainly belongs to the garnet family, and is probably merely a varicty of cinnamon stone; from which it appears to differ chiefly in being of a redder hue, and in this respect approaches pyrope.

The zircon family is richer in Ceylon than in any other part of the world. It is chiefly confined to the districts of Matura and Saffragam, more especially to the former, and is indicated by the popular name 'Matura diamond,' which is applied to its finest varieties by the dealers in gems. Besides the well known species, common zircon and hyacinth, a third species, massive, opaque, uncrystallized, and of a dark brown colour, some specimens of which, from Saffragam, have been known to weigh two or three ounces, has been also found. The natives are completely ignorant of

the true nature of zircon. The yellow varieties are sold by them as a peculiar kind of topaz; the green as tourmaline; the red hyacinth as inferior rubies; and the very light grey as imperfect diamonds. All the varieties on sale are found in the beds of rivers, or in alluvial ground derived from the decomposition of gneiss or granitic rock. It is to be seen, however, in its original site in these districts sparingly disseminated through quartz and schorl rocks, or quartz and felspar with tablespar and graphite. The zircon in some parts of the mass so largely preponderates as almost to entitle the rock to be called zircon rock. The mineral in such a case is crystalline, and most commonly green or brown; the rock is remarkable for its heaviness, and for the resinous lustre of its fracture.

For the ruby family (Lankaretté *Singh.*), Ceylon is no less celebrated. Four species of it, spinell, sapphire, corundum, and chrysoberyl occur in gneiss or granitic rock. Spinell is comparatively rare, though there are some small and most beautiful crystals of it found in the interior, and it is found in specimens of clay iron-ore in parts of the Central Province, where gneiss prevails. Sapphire is common though widely scattered; it occurs in great perfection and in considerable abundance and magnitude in the granitic alluvium of Matura and Saffragam, and about Nuwera Elliya; the principal varieties being the blue, purple, red, yellow, white and star-stone. Barbosa remarks that the Singhalese in his day bleached sapphires in such perfection, that they might be taken for the finest diamonds. Fragments of blue sapphire of indifferent quality have been found as large as a goose's egg. The purple variety or the oriental amethyst is rare. A green variety is still rarer, and when found, perhaps, owes its colour to a blending of blue and yellow, two colours of frequent occurrence in the same stone. The black sapphire is no less rare. It is not uncommon to find some other mineral included in the substance of the sapphire, such as crystals of iron glance, or a small mass of crystallized mica. Corundum is less frequently met with than the sapphire, being rarely found except in Ouva, where it is found in the bed and in the banks of a small stream; the sand, gravel, and pebbles among which the corundum occurs, in their nature correspond with varieties of granite, gneiss and hornblende rock. The corundum is often found in large six-sided prisms, it is commonly of a brown colour, whence it is called by the natives koroondu galle (cinnamon stone). Occasionally it is to be met with partially or entirely covered with a black crust, perhaps merely the stone with an unusual proportion of iron. The corundum and sapphire are so closely akin, that the natives have even observed the similarity. The two minerals are linked together by the coarse and opaque varieties of the latter, which are common enough in Saffragam. Chrysoberyl is of very rare occurrence, and is said to be brought from Saffragam. The more perfect crystals of all the varieties of ruby, sapphire, corundum and chrysoberyl, exhibiting in every direction smooth facets like the garnet, the diamond, and so many other minerals, seem to shew that they are contemporaneous in their formation with the rock from whence they are derived; that they have crystallized in its substance; and that they are not detached till it undergoes disintegration or decomposition, when they are washed by the heavy rains and torrents with the detritus of their parent rock to lower ground to reward the perseverance of the native explorers who might search in vain in the mountain mass. Corundum is the only species of this family that is not esteemed as a gem, and the only one that is applied to any purpose of utility. In its powdered state it is extensively employed by the lapidary in cutting and polishing stones, and by the armourer in polishing arms. It enters, too, into the composition of an excellent hone made by natives, consisting chiefly of this mineral in very fine powder, and of kapitia a peculiar kind of resin.

Of the felspar family, it is highly probable that several species exist in the island. Tablespar has been already alluded to, and the subdivisions of felspar *viz*, adularia (including glassy felspar), Labrador-stone, common felspar, and compact felspar. These minerals are common in gneiss and granitic

rock, with the exception of Labrador stone, which is seldom found, and then in a bed of graphic granite. Adularia is very abundant in some parts of the interior, particularly in the neighbourhood of Kandy, where it is occasionally the predominating ingredient of the rock.

Of the hornblende family, two species occur, common hornblende, the constituent of the rock of this name and glassy tremolite which has been observed at Trincomalee in a narrow vein of quartz in gneiss.

Pitchstone is perhaps the only mineral of the family of this name to be found in Ceylon, a small vein of it occurs near Trincomalee in granite. Mica or glimmer (Miniran, *Singh.*), as a constituent part of granite and gneiss is abundant, besides, it often occurs in large plates imbedded in these rocks. It is collected by the natives, who use it for purposes of ordinary decoration, and for ornamenting talipot parapluies. Common chlorite is occasionally to be met with both at Galle and Trincomalee disseminated through quartz. Green earth is more rare; it is found in Lower Ouva, where it is pretty abundant near Alipoot in small veins, and includes masses in clay derived from the decomposition of a granitic rock. This mineral is of an unusually light colour, varying from green to light apple-green.

Magnesian minerals are far from abundant in Ceylon, and are perhaps confined to dolomite, carbonate of magnesia, and talc. The very rare mineral, native carbonate of magnesia, has been discovered in a nitre cave, accompanied with dolomite and encrusting and included in gneiss. The best specimens of it were of a pure snow-white, earthy texture, rather harsh to the touch, destitute of smell when breathed on, and not adhesive. A specimen of it, examined by Dr. Davy, contained 86 carbonate of magnesia, 5 water, 9 silica, with some slight traces of carbonate of lime.

This mineral is perhaps co-temporary with the rock in which it occurs, and not deposited subsequently from water. It has long been used by the natives of the adjoining country in whitewashing their temples. Talc is very rare in Ceylon. It has been met with at Doombera in a nitre cave, where, with calcspar, felspar and quartz, it entered into the composition of a highly crystalline rock.

Calcspar, anhydrous gypsum, and calcsinter are the only pure calcareous minerals to be found in Ceylon The two former, well crystallised, have been met with at Doombera nitre cave. They occur in the compound rock just alluded to in reference to talc. Calcsinter is not uncommon; encrusting rocks of dolomite and gneiss, it abounds in Mátalé, and is plentiful in Lower Ouva, and in many places in the vicinity of dolomite rock, from which in all probability it is derived.

There are two kinds of the inflammable class of minerals that occur in Ceylon, graphite and sulphur. Graphite in minute scales is very commonly disseminated through gneiss, and it occasionally occurs imbedded in this rock in small masses. In the latter form, it is found to some extent in parts of Upper Saffragam, and might probably be found in sufficient quantity to be collected and exported profitably. Sulphur is extremely rare in Ceylon, indeed its very existence is not indisputably proved. A specimen of this mineral was some time ago picked up in Doombera, which contained a large portion of sulphate, a small portion of sulphate of iron, and slight traces of alum. The stone itself was composed chiefly of quartz, felspar and oxide of iron, and of some grey crystalline grains. Had the specimen been broken from a rock, little room for doubt would have remained, but even as the case stood, it appeared more likely to be native sulphur than an artificial accidental impregnation, for which indeed it would be almost impossible to account. The mineral productions occurring in the dolomite rock are of two kinds, those peculiar to it and hitherto found in no other rock in Ceylon, and those common to it and to granitic rock. Belonging to the latter, the following minerals may be enumerated:—Iron pyrites, mica, white clay, probably derived from the decomposition of felspar and graphite. With the exception of mica, none of these minerals are common or abundant in dolomite. The mica is generally of a light brown or straw-colour, trans-

lucent and crystallised in small six-sided prisms. The minerals peculiar to dolomite are three in number, Ceylanite, apatite and a bright yellow mineral, perhaps a variety of cinnamon-stone. Ceylanite is pretty abundant in this rock, and very generally disseminated through it. It occurs crystallized and amorphous, and exhibits a variety of colours, as bright azure-blue, resembling the blue sapphire, violet, pink-red, grey and white. Its crystals are generally very small. The fine sapphire blue Ceylanite is almost confined to one locality. Of the pink-red, some good specimens have been met with from a vein of dolomite in Saffragam, on the banks of a stream that flows into the Kalu-ganga. Ceylanite of the other colours is common particularly in the dolomite rock near Kandy and Badulla, where it generally occurs amorphous, or very indistinctly crystallised. Apatite, of a bright sapphire-blue colour, is frequently to be seen in dolomite, disseminated in very minute particles. It occurs in one place well crystallised, in six-sided prisms in a few places. The bright yellow mineral, perhaps, a variety of the cinnamon-stone, which it resembles in its general properties, and has never been seen crystallised, is not uncommon in dolomite in the vicinity of Kandy. This result is difficult to ascertain from the small particles in which it is found. Though, then, the number of minerals hitherto found in dolomite rock is small, it is highly probable more may yet be found to reward the mineralogist, who may search in the quarries of the interior, where it is broken for making lime.

SKETCH OF THE GEOLOGY OF CEYLON:

By George Gardner, F.L.S.

(From "*Ribeyro's Ceylon*" *by George Lee.*)

The island of Ceylon appears, at an early period of its physical history, to have formed the southern extremity of the peninsula of India. This opinion is confirmed both by its position and its geological constitution. At the present period the narrow channel which separates them is only a few feet in depth, and I believe I shall be able to prove that the whole of Ceylon is gradually rising above the sea level, and that consequently the time, geologically speaking, is not far distant when the island will again become united to the continent. Tradition, indeed, records that the passage was at one time not only broader but much deeper than it now is, and this led to the survey which preceded the deepening of the Pomban passage.

The island is about 270 miles long, by about 145 in breadth. It is of an ovate form, and its extremities point nearly due south and north. It is broadest at its southern extremity, and it is in that direction that the greatest mass of high land exists. The great central mountain range rises, for the most part, rather suddenly out of a broad belt of flat country that stretches between it and the sea, and which varies from twenty to sixty or eighty miles in breadth, but towards the north, north-west, and north-east, the flats are much broader than in any other direction. The general direction of the mountain chain is from south to north, but it is much broken up, and intersected by beautiful broad and fertile vallies, varying from one to six thousand feet above the level of the sea. The mountains themselves vary from 3,000 to 8,280 feet, the latter being the elevation of Pedrotalagalla, a rounded dome which overlooks the valley of Newera Ellia on the one side and that of Maturatta on the other. The peaks which come next to this one in point of elevation are Kirigal-potta, to the south of it, which is 7,810 feet; Totapella, to the eastward, which is 7,720 feet; and Adam's Peak, which for a long period was considered, as it still is by the natives, to be the highest of all, 7,420 feet. Taking their rise in these mountains, and traversing the valleys, are, of course, a number of streams of various sizes. The largest of these is the Mahawelli-ganga—the Ganges of Ptolemy—which has its origin near the summit of Pedrotalagalla, and, after a very tortuous course of nearly 200 miles, ultimately falls into

the sea near Trincomalee, on the north-east side of the island. Three or four other streams of considerable size empty themselves on the west coast.

Although the geological structure of the Island is very simple, it offers notwithstanding much that is interesting to the geologist. The series of rocks are but few in number. The lowest, which is also the most common, is that to which the name of gneiss is given. In some places it is overlaid by extensive beds of Dolomitic lime-stone; and on some parts of the coast that very modern formation known by the name of Breccia is found to exist. The clay slate, silurian, old red sand-stone, carboniferous, new red sand-stone, oolite, and chalk systems, which form such remarkable features in the Geology of England, have not yet been met with in Ceylon, nor is it at all probable that any of them ever will be found, as the island has now been traversed in all directions without any traces of them having been seen.

Gneiss rocks are the lowest of that division to which the name of stratified is given, in contra-distinction to those which show no traces of stratification, such as granite, basalt, and lavas. Wherever the undersurface of the Gneiss series is sufficiently exposed, it is always found to rest on granite; but owing to the great thickness of the system in Ceylon, and notwithstanding that it has been much broken by the upheaval of the mountains, I have not yet been able to trace their connection. It has however, recently been discovered at Mount Lavinia, near Colombo, by the Rev. Dr. Macvicar. The mechanical structure of Gneiss shews that it has been formed at the expense of granite by disintegration, much in the way that the sand-stone of the carboniferous system has had its origin, and that which is now being formed on the sea-shores of our own times; and that it has afterwards been partly fused by heat from below. Mr. Lyell, indeed, asserts, and all that we yet known of Geology goes to prove the truth of the assertion, that granite itself has been formed by the complete fusion and reconsolidation of pre-existing stratified rocks, and that as new stratified rocks are slowly deposited by water above the earth, the older ones which they cover are gradually reabsorbed by the interior heat of the globe, and converted into granite. According to this view we have, as in the organic world, an endless rouud of production and decay going on from pre-existing materials; and it is from this circumstance that Mr. Lyell has given the name of metamorphic rocks to those lower stratified ones, to which the name of transition was formerly applied.

The materials of which gneiss and granite are formed are the same, consisting of the minerals called felspar, mica, quartz, and hornblende, in greater or less proportions; but if a portion of each be carefully examined, these materials will be found to be in a very different state of molecular aggregation. In granite these minerals are always found to be perfectly crystallized within, and to have externally a regular geometric figure, while in gneiss, though the internal crystallization remains, the felspar is rounded like water-worn pebbles, or broken into fragments, and the plates of mica are contorted by irregular pressure among the felspar and quartz, shewing that they were brought together by the mechanical influence of water, and not by chemical attraction while in a state of fusion, as in granite. These distinctions, however, are only of practical value when small portions of either rock are under investigation, for while granite in the mass presents no evidence of stratification, in gneiss, on the contrary, it is always observable, particularly where sections of the rock in *situ* have been made; and as such sections are now everywhere to be met with along the new roads which intersect the interior of the island, the various bendings, elevations and depressions which these rocks have been subjected to since they were quietly and horizontally deposited in the bed of a primæval ocean, can be very satisfactorily studied.

Portions of these rocks are sometimes of a very arenaceous character, so much so, indeed, as often to cause them to be taken for actual sandstone by common observers. Such portions can always, however, be traced running into the regular and more compact gneiss. Extensive veins of both pure quartz and felspar are often met with in the gneiss, and probably have been

produced by the same cause which mineral veins owe their origin to, viz., a fissure which has been filled up from the surrounding rock by chemical and electrical action, long but steadily continued. Those chalk-like deposits which are met with at Newera Ellia and elsewhere, are formed by the disintegration of felspar veins, and constitute that substance to which the name of porcelain clay is given.

In several parts of the island the gneiss is intersected by veins of trap rocks, which have been thrown up from below in a molten state subsequent to the consolidation of the gneiss. Such veins or dykes may be seen on the beach between the Admiral's house and the dockyard at Trincomalee, on the ascent of Adam's Peak from Ratnapoora, and close to the sea on that side of Mrs. Gibson's hill which looks towards Galle. The latter consists of pitch-stone porphyry, highly impregnated with iron, and the effect which it has produced in altering the nature of the gneiss, where it has come in contact with it, is very striking.

With regard to the existence of metallic veins in the mountains of Ceylon almost nothing is known. Traces of tin have lately been said to have been met with; and it is not at all unlikely that it may hereafter be met with in greater abundance, as it is principally in the metamorphic rocks that metallic veins are found to exist, and mostly in mountainous countries or their immediate neighbourhood. As their existence however cannot be predicted, further knowledge concerning them will only be obtained by actual examination of those parts of the island most likely to possess them.

It is often asked if there is any chance of coal being found in Ceylon. Although from all that is yet known of the geology of the island, the chances are very much against any thing like a true coal formation being met with, yet it would not be safe to give a decided answer on the subject; for, unlike the carboniferous beds of England, which have in general one or more systems of stratified rocks intervening between them and the gneiss, those of the north of India were found by Dr. Royle to rest on the Gneiss itself. This much, however, is certain, that whenever Gneiss forms the uppermost rock, coal need never be looked for, as it is well known that in all parts of the world, the series of rocks which form the crust of it, hold a regular and undeviating relative position to each other, and hence, the upper rock of any country being given, a Geologist can tell with the greatest certainty what system or systems of rocks will never be found beneath it.

The nature and origin of laterite or kabuk, which is so common on the west side of the Island, have given rise to much diversity of opinion. Some have supposed it to be a volcanic production, and others a deposition from water; but I have most completely satisfied myself that it owes its existence to neither of these causes, but to the simple decay of Gneiss rocks. I was first led to this view from the examination of a cut through a knoll on the road from Galle to Balligam, and afterwards from others on the road between Colombo and Ambepusse, and in numerous instances of the same nature in the Central Province. In many of these cuts there is no difficulty in tracing a continuous connection, without any definite lines of demarcation, between the soil and the laterite on the one hand, and the laterite and the solid rock on the other. In no part of the world, save in the Peninsula of India, have I witnessed a like decomposition of Gneiss, and this renders it probable that the cause is due to some peculiarity in the chemical nature of the rock itself.

As in almost every other country where the Gneiss system prevails, immense deposits of crystalline lime-stone are found in various parts of the interior of the island, overlying the Gneiss. Thus, it is well known to occupy a large space in the vallies of Kundasale, Matale and Peradenia, at the latter place, and between it and Kandy, being extensively converted into lime for building purposes. This like all other lime-stone strata has evidently been formed by aqueous chemical deposition from an ocean which overlay the Gneiss, and its highly crystalline structure is probably owing to the same heat which partly fused the Gneiss itself previous to its solidification. It is not simply a carbonate of lime, but contains besides a considerable quantity of

carbonate of magnesia, and to such combinations the name of dolomite is given. It is still undecided by Geologists whether the magnesia of such rocks was originally contained in the solution from which they have resulted, or from the action of heat on the rocks with which they are connected, and which as is the case with Gneiss, are known to contain a certain proportion of Magnesia.

Passing over all those series of rocks to which the names of secondary and tertiary have been given, none of which are known to exist in Ceylon, we come to those very modern ones called post-tertiary, which are being formed at the present day, and which either shew themselves in the shape of elevated terraces of shells, or in a more solid form arising from the agglutination of particles of sand and fragments of such corallines and shells as still inhabit the surrounding seas. Such elevated shell banks, and such rocks are to be met with in several places along the coast. Thus the greater part of the Peninsula of Jaffna is formed of them, and I have likewise noticed their existence at Galle and at Belligam. The study of these modern formations are of peculiar interest to the geologist, as they are fraught with important analogies as to the process of nature in more ancient times. At Jaffna the lower portions of this breccial rock is quarried for building purposes. It is compact in its structure, but abounds in very perfect remains of shells and corals, and in its general structure resembles very much the same kind of rock in which human remains have been found on the north-east coast of the main land of Guadaloupe. Along the shores of the lagoon which separates the main land from the peninsula of Jaffna, and but little elevated above the present sea level, the formation of this rock may be seen in various states of progress towards solidification. Some specimens which I collected there consist of nearly an entire mass of small shells similar to those which are still found abundantly alive within the present tidal range, and are beautiful examples of the manner in which those lime-stone rocks of the secondary strata which are so full of the remains of shells and other marine animals, have been formed. At Galle a somewhat similar kind of rock is used for building purposes, but the shells and corallines of which it is composed are more comminuted. At one of the places where this rock is worked, situated about a mile from the sea, and about six or eight feet above its present level, I found firmly attached to those portions of it which were exposed by the removal of the alluvial soil which covered them, numerous oyster shells, exactly similar to those now found alive on rocks at present washed by the waves of the ocean. At Belligam a large tract of alluvial land, which at the time I visited that place, in 1844, was planted with sugar cane, is underlaid by a thick stratum of sea shells and fragments of corallines, which are more or less firmly agglutinated together; and I have no doubt that many other parts of the coast offer similar phenomena.

The existence of these masses of shells above the present level of the sea, yields the same evidence of the gradual rise of the island of Ceylon, that is afforded by similar appearances in other parts of the world, and from which similar conclusions have been drawn by the most eminent geologists of the day. In many places where such rises are slowly but surely going on, the rate is so imperceptible that but little change has been observed during the historical period; whereas in others, such as the Scandinavian peninsula, the rise is as much as three feet in the course of a century. From all that I have seen I am led to believe that the whole of that flat sandy country which stretches along the west coast of Ceylon, as well as that of a similar nature at Batticalea, which, except Trincomalee which is rocky, is the only part of the east coast that I have yet visited, has, at no very recent geological epoch been gained from the sea by the elevation of the land.

The conclusions to be deduced from the above slight sketch of the Geology of the Island are very evident. In the first place, the non-existence of secondary and tertiary rocks overlying the Gneiss and Dolomite, prove that from the period of the first elevation of Ceylon above the level of the ocean,

it has not been subjected to the numerous submersions and upheavals which, it is well ascertained, such countries as possess them have been liable to: indeed, there is no evidence to prove that it has even once been covered with water since the time at which it first became dry land, for nearly the whole of the soil which covers it, with the exception of the sandy portions along the coast, and a very thin layer of alluvial matter has been formed from the decay of the gneiss rocks. Nowhere have I met with traces of diluvial drift, except, indeed, where it can be traced to the action of streams. In the second place, the gradual rise of the whole island may be fairly inferred from the existence of the elevated beaches which I have alluded to, and I have no doubt that when further attention has been given to the subject by those who have opportunities for so doing, still more satisfactory evidence of the fact will be afforded.

METALS, MINERALS AND GEMS.

(From *Sir Emerson Tennent's "Ceylon."*)

METALS.—The plutonic rocks of Ceylon are but slightly metalliferous, and hitherto their veins and deposits have been but imperfectly examined. The first successful survey attempted by the Government was undertaken during the administration of Viscount Torrington, who, in 1847, commissioned Dr. Gygax to proceed to the hill district south of Adam's Peak, and furnish a report on its products. His investigations extended from Ratnapoora in a south-eastward direction, to the mountains which overhang Bintenne, but the results obtained did not greatly enlarge the knowledge previously possessed. He established the existence of *tin* in the alluvium along the base of the mountains to the eastward towards Idelgashena; but so circumstanced, owing to the flow of the Wellaway river, that, without lowering its level, the metal could not be extracted with advantage. The position in which it occurs is similar to that in which tin ore presents itself in Saxony; and along with it, the natives, when searching for gems, discover garnets, corundum, white topazes, zircon, and tourmaline.

Gold is found in minute particles at Gettyhedra, and in the beds of the Maha Oya and other rivers flowing towards the west.(*a*) But the quantity hitherto discovered has been too trivial to reward the search. The early inhabitants of the island were not ignorant of its presence; but its occurrence on a memorable occasion, as well as that of silver and copper, is recorded in the Mahawanso as a miraculous manifestation, which signalised the founding of one of the most renowned shrines at the ancient capital.(*b*)

Nickel and *cobalt* appear in small quantities in Saffragam, and the latter, together with *rutile* (an oxide of titanium) and *wolfram*, might find a market in China for the colouring of porcelain. (*c*) *Tellurium*, another rare and valu-

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a Ruanwella, a fort about forty miles distant from Colombo, derives its name from the sands of the river which flows below it,—rang-welle, "golden sand." "Rang-galla," in the central province, is referable to the same root—the rock of gold.

b Mahawanso, ch. xxiii. p. 166, 167.

c Asiatic Annual Register for 1799 contains the following:—

"*Extract from a letter from Colombo dated 26th Oct.* 1798.

"A discovery has been lately made here of a very rich mine of *quicksilver*, about six miles from this place. The appearances are very promising, for a handful of the earth on the surface will, by being washed, produce the value of a rupee. A guard is set over it, and accounts sent express to the Madras Government."—P. 53. See also PERCIVAL'S *Ceylon*, p. 539.

JOINVILLE, in a MS. casay on *The Geology of Ceylon*, now in the library of the East India Company, says that near Trincomalie there is "un sable noir, composé de détriments de trappe et de cristaux de fer, *dans lequel on ouve per le lavage beaucoup de mercure.*"

able metal, hitherto found only in Transylvania and the Ural has likewise been discovered in these mountains. *Manganese* is abundant, and *Iron* occurs in the form of magnetic iron ore, titanite, chromate, yellow hydrated, peroxide and iron pyrites. In most of these, however, the metal is scanty, and the ores of little comparative value, except for the extraction of manganese and chrome. "But there is another description of iron ore," says Dr. Gygax, in his official report to the Ceylon Government, "which is found in vast abundance, brown and compact, generally in the state of carbonate, though still blended with a little chrome, and often molybdena. It occurs in large masses and veins, one of which extends for a distance of fifteen miles; from it millions of tons might be smelted, and when found adjacent to fuel and water-carriage, it might be worked to a profit. The quality of the iron ore found in Ceylon is singularly fine; it is easily smelted, and so pure when reduced as to resemble silver. The rough ore produces from *thirty* to *seventy-five* per cent., and on an average fully *fifty*. The iron wrought from it requires no puddling, and, converted into steel, it cuts like a diamond. The metal could be laid down in Colombo at £6 per ton, even supposing the ore to be brought thither for smelting, and prepared with English coal; but *anthracite* being found upon the spot, it could be used in the proportion of three to one of the British coal; and the cost correspondingly reduced."

Remains of ancient furnaces are met with in all directions precisely similar to those still in use amongst the natives. The Singhalese obtain the ore they require without the trouble of mining; seeking a spot where the soil has been loosened by the latest rains, they break off a sufficient quantity, which, in less than three hours, they convert into iron by the simplest possible means. None of their furnaces are capable of smelting more than twenty pounds of ore, and yet this quantity yields from seven to ten pounds of good metal.

The *anthracite* alluded to by Dr. Gygax is found in the southern range of hills near Nambepane, in close proximity to rich veins of *plumbago*, which are largely worked in the same district, and the quantity of the latter annually exported from Ceylon exceeds a thousand tons. (*a*) *Molybdena* is found in profusion dispersed through many rocks in Saffragam, and it occurs in the alluvium in grey scales, so nearly resembling plumbago as to be commonly mistaken for it. *Kaolin*, called by the natives *Kirimattie*, appears at Neuraellia, at Hewahette, Kaduganawa, and in many of the higher ranges as well as in the low country near Colombo; its colour is so clear as to suit for the manufacture of porcelain (*b*); but the difficulty and cost of carriage render it as yet unavailng for commerce and the only use to which it has hitherto been applied is to serve for whitewash instead of lime.

Nitre has long been known to exist in Ceylon, where the localities in which it occurs are similar to those in Brazil. In Saffragam alone there are upwards of sixty caverns known to the natives, from which it may be extracted, and others exist in various parts of the island, where the abundance of wood to assist in its lixiviation would render that process easy and profitable. Yet so sparingly has this been hitherto attempted, that even for pur-

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a That was twenty-five years ago: now as much as 8,000 tons of plumbago are sometimes exported in one year.—COMPILERS.

b The Kaolin of Ceylon, according to an analysis in 1847, consists of—

Pure kaolin	70·0
Silica	26·0
Molybdena and iron oxide...	4·0
	100·0

In the *Ming-she*, or history of the Ming dynasty, A. D. 1368—1643, by Chanting-yuh, "pottery-stone" is enumerated among the imports into China from Ceylon.—B. cccxxvi. p. 5. [A cup and saucer made from Ceylon kaolin by "Minton" to the order of Governor Sir William Gregory, will be found in the Colombo Museum.—COMPILERS.]

poses of refrigeration, crude saltpetre is still imported from India.(*a*)

GEMS.—But the chief interest which attaches to the mountains and rocks of the region, arises from the fact that they contain those mines of *precious stones* which from time immemorial have conferred renown on Ceylon. The ancients celebrated the gems as well as the pearls of "Taprobane;" the tales of mariners returning from their eastern expeditions supplied to the story-tellers of the Arabian Nights their fables of the jewels of "Serendib;" and the travellers of the Middle Ages, on returning to Europe, told of the "sapphires, topazes, amethysts, garnets, and other costly stones" of Ceylon, and of the ruby which belonged to the king of the island, "a span in length, without a flaw, and brilliant beyond description." (*b*)

The extent to which gems are still found is sufficient to account for the early traditions of their splendour and profusion; and fabulous as this story of the ruby of the Kandyan kings may be, the abundance of gems in Saffragam has given to the capital of the district the name of *Ratnapoora*, which means literally "the city of rubies." (*c*) They are not, however, confined to this quarter alone, but quantities are still found on the western plains between Adam's Peak and the sea, at Neuera-ellia, in Ouvah, at Kandy, at Matelle in the Central Province, and at Ruanwelli near Colombo, at Matura, and in the beds of the rivers eastwards towards the ancient Mahagam.

But the localities which chiefly supply the Ceylon gems are the alluvial plains at the foot of the stupendous hills of Saffragam, in which the detritus of the rocks has been carried down and intercepted by the slight elevations that rise at some distance from the base of the mountains. The most remarkable of these gem-bearing deposits in the flat country around Ballangodde, south-east of Ratnapoora; but almost every valley in communication with the rocks of the higher ranges contains stones of more or less value, and the beds of the rivers flowing southward from the mountain chain are so rich in comminuted fragments of rubies, sapphires, and garnets, (*d*) that their sands

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a The mineralogy of Ceylon has hitherto undergone no scientific scrutiny, nor have its mineral productions been arranged in any systematic and comprehensive catalogue. Specimens are to be found in abundance in the hands of native dealers; but from indifference or caution they express their inability to afford adequate information as to their locality, their geological position, or even to show with sufficient certainty that they belong to the island. Dr. Gygax, as the results of some years spent in exploring different districts previous to 1847, was enabled to furnish a list of but thirty-seven species, the site of which he had determined by personal inspection. These were:—1, Rock crystal, Abundant; 2, Iron quartz, Saffragam; 3, Common quartz, Abundant; 4, Amethyst, Galle Back, Caltura; 5, Garnet, Abundant; 6, Cinnamon stone, Belligam; 7, Harmotome, St. Lucia, Colombo; 8, Hornblende, Abundant; 9, Hypersthene, Abundant; 10, Common corundum, Badulla; 11, Ruby, Badulla and Saffragam; 12, Chrysoberyl, Ratganga, North Saffragam; 13, Pleonaste, Badulla; 14, Zircon, Wallawey-ganga, Saffragam; 15, Mica, Abundant; 16, Adular, Patna Hills, North-east; 17, Common felspar, Abundant; 18, Green felspar, Kandy; 19, Albite, Melly Matté; 20, Chlorite, Kandy; 21, Pinite, Patna Hills; 22, Black tourmaline, Neuera-ellia; 23, Calcspar, Abundant; 24, Bitterspar, Abundant; 25, Apatite, Galle Back; 26, Fluorspar, Galle Back; 27, Chiastolite, Mount Lavinia; 28, Iron pyrites, Peradenia; 29, Magnetic iron pyrites, Peradenia, Rajawelle; 30, Brown iron ore, Abundant; 31, Spathose iron ore, Galle Back; 32, Manganese, Saffragam; 33, Molybdena glance, Abundant; 34, Tin ore, Saffragam; 35, Arseniate of nickel, Saffragam; 36, Plumbago, Morowa Corle; 37, Epistilbite, St Lucia.

b *Travels of* MARCO POLO, *a Venetian, in the Thirteenth Century*, Lond. 1818.

c In the vicinity of Ratnapoora there are to be obtained masses of quartz of the most delicate rose colour. Some pieces, which were brought to me in Colombo, were of extraordinary beauty; and I have reason to believe that it can be obtained in pieces large enough to be used as slabs for tables, or formed into vases and columns. I may observe that similar pieces are to be found in the south of Ireland, near Cork.

d MR. BAKER, in a work entitled *The Rifle and the Hound in Ceylon*, thus describes the sands of the Manic Ganga, near the ruins of Mahagam:

in some places are used by lapidaries in polishing the softer stones, and in sawing the elephants' grinders into plates. The cook of a government officer at Galle recently brought to him a ruby about the size of a small pea, which he had taken from the crop of a fowl.

Of late year considerable energy has been shown by those engaged in the search for gems; neglected districts have been explored, and new fields have been opened up at such places as Karangodde and Weraloopa, whence stones have taken of unusual size and value.

It is not, however, in the recent strata of gravel, nor in those now in process of formation, that the natives search for gems. They penetrate these to the depth of from ten to twenty feet, in order to reach a lower deposit distinguished by the name of *Nellan* in which the objects of their search are found. This is of so early a formation that it underlies the beds of rivers, and is generally separated from them or from the superincumbent gravel by a hard crust (called *Kadua*), a few inches in thickness. and so consolidated as to have somewhat the appearance of laterite, or of sun-burnt brick. The nellan is for the most part horizontal, but occasionally it is raised into an incline as it approaches the base of the hills. It appears to have been deposited previous to the eruption of the basalt, on which in some places it reclines, and to have undergone some alteration from the contact. It consist of water-worn pebbles firmly imbedded in clay, and occasionally there occur large lumps of granite and gneiss, in the hollows under which, as well as in "pockets" in the clay (which from their shape the natives denominate "elephants' footsteps") gems are frequently found in groups as if washed in by the current.

The persons who devote themselves to this uncertain pursuit are chiefly Singhalese, and the season selected by them for "gemming" is between December and March, when the waters are low. (*a*) The poorer and least enterprising adventurers betake themselves to the beds of streams, but the most certain though the most costly course is to sink pits in the adjacent plains, which are consequently indented with such traces of recent explorers. The upper gravel is pierced, the covering crust is reached and broken through and the nellan being shovelled into conical baskets and washed to free it from the sand, the residue is carefully searched for whatever rounded crystals and minute gems it may contain.

It is strongly characteristic of the want of energy in the Singhalese, that although for centuries those alluvial plains and watercourses have been searched without ceasing, no attempt appears to have been made to explore the rocks themselves, in the débris of which the gems have been brought down by the rivers. Dr. Gygax says: "I found at Hima Pohura, on the south-eastern decline of the Pettigalle-Kanda, about the middle of the descent, a stratum of grey granite containing, with iron pyrites and molybdena, innumerable rubies from one tenth to a fourth of an inch in diameter, and of a fine rose colour, but split and falling to powder. It is not an isolated bed of minerals, but a regular stratum extending probably to the same depth and distance as the other granite formations. I followed it as far as was practicable for close examination, but everywhere in the lower part of the valley I found it so decomposed that the hammer sunk in the rock, and even bamboos were growing on it. On the higher ground near some small round hills which intercept it, I found the rubies changed

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in the south-eastern extremity of the island:—"The sand was composed of mica, quartz, sapphire, ruby, and jacinth; but the large proportion of ruby sand was so extraordinary that it seemed to rival Sinbad's story of the vale of gems. The whole of this was valueless, but the appearance of the sand was very inviting, as the shallow stream in rippling over it magnified the tiny gems into stones of some magnitude. I passed an hour in vainly searching for a ruby worth collecting, but the largest did not exceed the size of a mustard seed."—BAKER'S *Rifle and Hound in Ceylon*, p. 181.

a A very interesting account of *Gems and Gem Searching*, by Mr. WM. STEWART, appeared in the *Colombo Observer* for June, 1855. [See page 111 *et seq.*—COMPILERS.

into brown corundum. Upon the hills themselves the trace was lost, and instead of a stratum there was merely a wild chaos of blocks of yellow granite. I carefully examined all the minerals which this stratum contains:—felspar, mica, and quartz molybdena, and iron pyrites,—and I found all similar to those I had previously got adhering to rough rubies offered for sale at Colombo. *I firmly believe that in such strata the rubies of Ceylon are originally found,* and that those in the white and blue clay at Ballangodde and Ratnapoora are but secondary deposits. I am further inclined to believe that these extend over the whole island, although often intercepted and changed in their direction by the rising of the yellow granite." It is highly probable that the finest rubies are to be found in them, perfect and unchanged by decomposition; and that they are to be obtained by opening a regular mine in the rock like the ruby mine of Badakshan in Bactria described by Sir Alexander Burnes. Dr. Gygax adds that having often received the minerals of this stratum with the crystals perfect, he has reason to believe that places are known to the natives where such mines might be opened with confidence of success.

Rubies both crystalline and amorphous are also found in a particular stratum of dolomite at Ballatotte and Badulla, in which there is a peculiar copper-coloured mica with metallic lustre. *Star rubies*, the "asteria" of Pliny (so called from their containing a movable six-rayed star), are to be had at Ratnapoora and for very trifling sums. The blue tinge which detracts from the value of the pure ruby, whose colour should resemble "pigeon's blood," is removed by the Singhalese, by enveloping the stone in the lime of a calcined shell and exposing it to a high heat. *Spinel* of extremely beautiful colours is found in the bed of the Mahawelli-ganga at Kandy, and from the locality it has obtained the name of *Candite.*

It is strange that although the *sapphire* is found in all this region in greater quantity than the ruby, it has never yet been discovered in the original matrix, and the small fragments which sometimes occur in dolomite show that there it is but a deposit. From its exquisite colour and the size in which it is commonly found, it forms by far the most valuable gem of the Island. A piece which was dug out of the alluvium within a few miles of Ratnapoora in 1853, was purchased by a Moor at Colombo, in whose hands it was valued at upwards of four thousand pounds.

The original site of the *oriental topaz* is equally unknown with that of the sapphire. The Singhalese rightly believe them to be the same stone only differing in colour, and crystals are said to be obtained with one portion yellow and the other blue.

Garnets of inferior quality are common in the gneiss, but finer ones are found in the hornblende rocks.

Cinnamon-stone (which is properly a variety of garnet) is so extremely abundant, that vast rocks containing it in profusion exist in many places, especially in the alluvium around Matura; and at Belligam, a few miles east from Point-de-Galle, a vast detached rock is so largely composed of cinnamon-stones that it is carried off in lumps for the purpose of extracting and polishing them.

The *Cat's-eye* is one of the jewels of which the Singhalese are especially proud, from a belief that it is only found in their island; but in this I apprehend they are misinformed, as specimens of equal merit have been brought from Quilon and Cochin on the southern coast of Hindostan. The cat's-eye is a greenish translucent quartz, and when cut *en cabochon* it presents a moving internal reflection which is ascribed to the presence of filaments of asbestos. Its perfection is estimated by the natives in proportion to the narrowness and sharpness of the ray and the pure olive-tint of the ground over which it plays.

Amethysts are found in the gneiss, and some discoloured though beautiful specimens in syenite; they are too common to be highly esteemed. The "Matura Diamonds," which are largely used by the native jewellers, consist of zircon, found in the syenite not only uncoloured, but also of pink and yellow tints, the former passing for rubies.

But one of the prettiest though commonest gems in the island is the "Moon-stone," a variety of pearly adularia presenting chatoyant rays when

simply polished. They are so abundant that the finest specimens may be bought for a few shillings. These, with *aqua marina*, a bad description of *opal rock crystal* in extremely large pieces, *tourmaline*, and a number of others of no great value, compose the list of native gems procurable in Ceylon. (*a*) Diamonds, emeralds, agates, cornelians, opal and turquoise, when they are exhibited by the natives, have all been imported from India.

During the dynasty of the Kandyan sovereigns, the right of digging for gems was a royalty reserved jealously for the King; and the inhabitants of particular villages were employed in their search under the superintendence of hereditary officers, with the rank of "Mudianse." By the British Government the monopoly was early abolished as a source of revenue, and no license is now required by the jewel-hunters,

Great numbers of persons of the worst-regulated habits are constantly engaged in this exciting and precarious trade; and serious demoralisation is engendered amongst the villagers by the idle and dissolute adventurers who resort to Saffragam. Systmatic industry suffers, and the cultivation of the land is frequently neglected whilst its owners are absorbed in these speculative and tantalising occupations.

The products of their searches are disposed of to the Moors, who resort to Saffragam from the low country, carrying up cloth and salt, to be exchanged for gems and coffee. At the annual Buddhist festival of the Perahara, a jewel-fair is held at Ratnapoora, to which the purchasers resort from all parts of Ceylon. Of late years, however, the condition of the people in Saffragam has so much improved that it has become difficult to obtain the finest jewels, the wealthier natives preferring to retain them as investments: they part with them reluctantly, and only for gold, which they find equally convenient for concealment. (*b*)

The lapidaries who cut and polish the stones are chiefly Moors, but their tools are so primitive, and their skill so deficient, that a gem generally loses in value by having passed through their hands. The inferior kinds, such as cinnamon-stones, garnets, and tourmaline, are polished by ordinary artists at Kandy, Matura, and Galle; but the more expert lapidaries, who cut rubies and sapphires, reside chiefly at Caltura and Colombo.

As a general rule, the rarer gems are less costly in Europe than in Colombo. In London and Paris the quantities brought from all parts of the world are sufficient to establish something like a market value; but, in Ceylon, the supply is so uncertain that the price is always regulated at the moment by the rank and wealth of the purchaser. Strange to say, too, there is often an unwillingness even amongst the Moorish dealers to sell the rarest and finest specimens; those who are wealthy being anxious to retain them, and few but stones of secondary value are offered for sale. Besides, the Rajahs and native Princes of India, amongst whom the passion for jewels is universal, are known to give such extravagant prices that the best are always sent to them from Ceylon.

From the Custom House returns it is impossible to form any calculation as to the value of the precious stones exported from the island. A portion only appears, even of those sent to England, the remainder being carried away by private parties. Of the total number found, one-fourth is probably purchased by the natives themselves, more than one-half is sent to the Continent of India, and the remainder represents the export to Europe. Computed in this way, the quantity of precious stones found in the island may be estimated at 10,000*l.* per annum. [This all refers to a generation back: now the amount is much greater, as much as £7,000 worth of gems having been picked up on one property in the Rakwana District in a twelvemonth.—COMPILERS.]

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a Caswini and some of the Arabian geographers assert that the diamond is found at Adam's Peak; but this is improbable, as there is no formation there resembling the *cascalhao* of Brazil or the diamond conglomerate of Golconda. If diamonds were offered for sale in Ceylon, in the time of the Arab navigators, they must have been brought thither from India. (*Journ. As. Soc. Beng.* xiii. 633.)

b So eager is the appetite for hoarding in these hills, that eleven rupees (equal to twenty-two shillings) have frequently been given for a sovereign.

PRECIOUS STONES.

(From *Philalethes'* "*Ceylon.*")

The mountains of Ceylon probably contain a variety of mineral treasures, which it is reserved for the future researches of philosophy, or of avarice, to disclose. Among the precious stones of the island, the emerald, with the cat's-eye, are held in the highest estimation. "Cat's-eye is the name given to a very hard stone, which approaches more or less to a white or green, and is semi-diaphanous, with a streak of the breadth of a line in the middle, which streak is much whiter than the stone itself, and throws its light to whatever side soever this is turned. In this respect therefore it resembles a cat's-eye, whence it derives its name." Thunberg, to whom I am indebted for this description, says, that the largest specimen which he saw of this species of stone was of the size of a hazel nut. Mr. Cordiner tells us, that a perfect cat's-eye of this size is worth 1,500 rix-dollars of Ceylon currency, or £150 sterling. Rubies, for which Ceylon was renowned at a very early period, are seldom found at present of any considerable size; and are not often larger than particles of gravel or grains of barley. The Indians speak of them as more or less ripe, which means more or less high-coloured. In proportion as the ruby is of a deeper red it is more transparent, and consequently of greater value. The Moors, according to Thunberg, say, that they approach in hardness nearest to the diamond.

The Moors are here the chief dealers in precious stones, both in their rough and in their polished state; but they are said to be very dexterous in imposing counterfeit for genuine gems. The precious stones of Ceylon are found more especially in the region of Matura. Sometimes they are discovered on the surface of the earth, and in other places at the depth of from one, two, or three, to twenty or more feet.

(From *Knox's* "*Ceylon.*")

In this island are several sorts of precious stones, which the king, for his part, has enough, and so careth not to have more discovery made. For in certain places, where they are known to be, are sharp poles set up fixed in the ground, signifying, that none, upon pain of being stuck and impaled upon those poles, presume so much as to go that way. Also there are certain rivers, out of which, it is generally reported, they do take rubies and sapphires for the king's use, and cat's-eye; and I have seen several pretty coloured stones, some as big as cherry-stones, some as buttons, and transparent, but understood not what they were. Rubies and sapphires I myself have seen here.

Here is iron and crystal in great plenty. Saltpetre they can make. Brimstone, some say, is here, but the king will not have it discovered. Steel they can make of their iron. Ebony in great abundance, with choice of tall and large timber. Cardamums, jaggery, rack, oil, black lead, turmeric, salt, rice, betel-nuts, musk, wax, pepper; which last grows here very well, and might be in great plenty if it had a vend; and the peculiar commodity of the island, cinnamon. Wild cattle and wild honey in great plenty in the woods; it lies in holes or hollow trees, free for any that will take the pains to get it. Elephant's teeth and cotton; of which there is good plenty growing in their own grounds, sufficient to make them good and strong cloth for their own use, and also to sell to the people of the Uplands, where cotton is not so plenty. All these things the land affords, and it might do it in much greater quantity if the people were but laborious and industrious; but that they are not, for the Chingulays are naturally a people given to sloth and laziness, if they can but any ways live, they abhor to work; only what their necessities force them to do, they do, that is, to get food and raiment. Yet in this I must a little vindicate them; for what indeed should they do with more than food and raiment, seeing, as their estates increase, so do their taxes also? And although the people be generally covetous, spending but little, scraping together what they can, yet such is the government they are under, that they are afraid to be known to have any thing, lest it be taken away from them. Neither have they any encouragement for their industry, having no vend by traffic and commerce for what they have got.

GEMS AND GEM SEARCHING IN SAFFRAGAM.

(From the *Colombo Observer*, June 11, 1855.)

Ratnapura, 8th June, 1855.

To the Editors of the Colombo Observer.

SIRS,—If you deem the accompanying account of the Gems and the Gem-men of Saffragam of sufficient interest to appear in your valuable paper, I shall feel obliged by your inserting it at the earliest convenience.

I remain, your most obedient servant,

J. F. STEWART.

AN ACCOUNT OF THE GEMS AND GEM-MEN OF THE DISTRICT OF SAFFRAGAM.

The District of Saffragam has from the earliest times been famed for the various sorts of precious stones and gems found in it, and no doubt its principal town Ratnapoora (*Anglice*, Gem City), owes its name to the circumstance. Tradition has it, that a peculiar people called "*Mookaro*," (probably a race of Malabars, some of whom, I believe, even now are called Mookara), were the first engaged in mining for gems, and that their leader whom the people now call "Mookery," a woman, had left the island, with a ship-load of precious stones, which said ship had foundered at sea through the evil influence of some demon or other. In support of this, the people now show mounds of earth and pits of different depths in gem-productive localities as the remains of their operations, and also adduce the fact of pieces of earthenware, beads, charcoal, &c , being found at great depths, where they could not possibly have found their way, unless such places were at some great distance of time excavated. And they further suppose that the original contrivance used for washing the gravel in which the gems are found was an earthen-vessel now called "Koraha," as the greater number of fragments of earthenware found in such places are those of such utensils, whereas the present means is a wicker-basket to be described hereafter.

To avoid technical names, the gems found in this district are the ruby, the sapphire, the topaz, the cat's-eye, the pink ruby, the green, yellow and white crystal [quartz], and the tormally [tourmaline].

The ruby (ratha of the Singhalese, and also called "neelakeutia" by them when there is a dash of blue in it) is the hardest and the most beautiful and valuable of the gem-tribe in Ceylon. It is scarce, and when found is of considerable size and seldom pure—that is without defects. But of late large sized once have been discovered, though not pure. The defects of this stone are many ; the principal which renders it almost valueless is what is called "*Coovangoo*," as in fact it does other stones, excepting the tormally, the value of which, when it exists in it to a certain degree, it enhances, converting it into a cat's-eye to be described hereafter. This "Coovangoo" is perhaps the result of imperfect crystalization. The other defects are cracks, and other flaws called "*mola neero*" which are dark specks in the body of the stone. From one or the other of these imperfections the stone is seldom found free. Then, the colour may be more o less than the standard, detracting from its value; but the tinge of blue which is frequently found in the stone (giving it the name of neelakentia) is easily removed by burning. The process is simple and is as follows :—The stone is enclosed in a thick coating of chunam [lime] (that which is used by the natives with their bettle-leaves) and then exposed to a strong heat. The operation is repeated until the whole of the blue tinge is removed. But care should be taken to subject only such stones as are perfeetly free from cracks to this, for one with cracks, if subjected to heat, is said to crumble down in pieces. This stone, the beautiful colour of which is so well known, is prized alike among Europeans and Asiatics.

The next stone of value is the sapphire. ("Nilla" Singhalese). It is perhaps the most plentifully disseminated (if the word the correct) of the gem tribe in the district.—Like its congeners, it is seldom found without blemish, and of the proper colour, though, it has frequently been discovered in largish

pieces. It is the next in value to the ruby, that variety called "*Indra Nella*" being reckoned the best by the Singhalese. In this sort there is a slight shadow of ruby-red as it were mixed up with blue. One of this variety, of an extraordinary size and purity, was found some time ago within a few miles of Ratnapoora, giving origin to great litigation among the people in whose land it was found. It is said to have changed hands, and to be now in the possession of a wealthy Moorman of Colombo who has refused the offer of £4,500 for the purchase of it. One has lately been found in a new *gem field* close to Ratnapoora of a smaller size, but of better colour as is said, than the one above described. The sapphire, the blue colour of which is so much admired, is equally valued by Europeans and natives.

The topaz (*puspa raga*, Singhalese) claims notice next. There are two varieties of it the "ratua puspa raga" and "kaha puspa raga."—The former is of a bright yellow colour, with a reddish tinge and is the more valued. The latter is pure bright yellow. The first variety is scarce, and the second is comparatively plentiful. The topaz and the sapphire seem to be species of the same stone differing only in colour—it is not unfrequent to find a piece of stone partly yellow and partly blue. This stone is not much sought after by Europeans, but it is prized among the Singhalese. It is said to sell well at the Presidencies of India and in Arabia.

The Cat's-eye ("Vyrody," Singhalese) as has already been noticed, is a toramally with a proper degree of "coovangoo" in it, now denominated the "pasanama" producing a movable, bright, white streak in it when properly cut and polished—so that a description of the cat's-eye is in fact one of the toramally. There are three varieties of the toramally, the "kanaka," "palla," and the "panny" toramally. The two first varieties when they have the pasanama, produce the cat's-eye (vyrody) the first being the superior sort. The "panny tormally" has seldom the coovangoo or pasanama in it, at least such a specimen has never been seen by the writer. The "kanaka" sort is distinguished by a light green colour with a golden gloss, having the white movable streak in it. The "palla" presents a deep green ground with the streak in it. The "panny" variety, which perhaps never produces a vyrody, is of a dull syruppy colour as the name indicates, panny meaning syrup. The cat's-eye though not much regarded by the Europeans, is much prized by Asiatics, particularly by the Malays, who it is said, give high prices for such as present more than one streak of white, of which it is said rare specimens have been met with. There is a variety of cat's-eye called "barawa vyrody." It is a perfectly blackstone with a moyable [shifting] streak in it. Of this sort the writer has seen several specimens.

The pink-ruby ("patmaraga" Singh.) is a beautiful stone and seldom met with. It is by some prized equally with the ruby. It is of a light ruby colour with a strong dash of a pink in it. This is likewise rarely found without blemish. It sells well when defectless, both among Europeans and Asiatics.

The last stone bearing the name precious, is the green-crystal ("nil palingo" Singh.) from its sea-green colour: it is commonly known as the *Aqua Marina*. It is seldom found large or defectless, though the other varieties of which there are two are found in large lumps. These latter, the yellow and the white (the kaha and sudo palingoo, Sing.) are almost valueless, the white sort being only used for spectacle glasses, though it also passes muster, when cut as brilliants, for real diamond among ornaments.

The part of the district productive in gems is the western portion of it, drawing a line from Balangodda in Meda Corle to Madampe in Atticalan Corle, extending it northwards to the limits of the district at the great mountain zone, and drawing it westwards from Madampe to the limits of Pasdoon Corle. In the western portion gems are found in all directions. The chief localities for gem searching have hitherto been Getehetta near Situaka, Niriella, Karewitte, Patakadu, Watapotta, Newitegalle, Boralogodda, Delwalla, and a few other places; and latterly Karangodda and Weralupa, where, though gems were formerly occasionally found, at present large and surer yields are had of a superior quality. There is no doubt, that at present gemming is better understood, and that it is conducted on an improved system and with greater

enterprise. Now the pits are excavated to greater depths in places where formerly no gravel (the matrix in which gems are found, called "*Ilian*" by the Singhalese,) was supposed to exist; whilst formerly the searchers were content to wash beds of gravel of an unsatisfactory nature situate superficially, and easier reached, but yielding an inferior description of produce. In fact it may be presumed that these superficial strata, are now exhausted, necessitating a search at greater depths, and including a sort of involuntary improvement. The pit where the great stone was found at Karangodda was at least 25 feet deep, whilst the pits now so productive at Weralupa are scarcely of less depth.

There are two ways in which gems are searched for—one in beds of streams, and the other by sinking pits on land, generally on the borders of streams, in which previously search had been made and found to contain the gravel At Weralupa both plans are now pursued—in the stream which runs through it, and on the meadow lands on its banks, the first discoverer of the deep-seated bed of gravel having been an enterprising resident of Ratnapoora. A correct description of these modes of gemming in water and on land (as the phrases run) may not be wholly without interest. In water gemmings the implements and appliances used are few and simple, consisting of a few mamoties (called "Menik Udalloo") stout, of an oblong square form, double the size of the ordinary ones, and concave on the handle surface, having a long pole called a reeta, of greater or less length according to the depth of the gravel, fixed to it for a handle; a few crow bars to break through any impediment that may be found in the way of getting at the "illan;" a long iron sounding-rod called *Illank ora*, and a close wicker-basket called *Menikwatta*," made of the prepared split bamboo-reed (batta). This wicker-basket is an admirable contrivance for the purpose it serves: it is basin-shaped but more conical and about two feet in diameter, with a strong rim of rattan. A dry season of the year being selected, generally between December and March, when the water in the streams is low and sluggish, the gem-men commence operations by putting away the sand in the spot selected, sounding with the sounding rod from time to time to see whether the gravel is at an accessible depth. In this part of the business the ordinary coolies assist, but not after the gravel has been exposed—when only the initiated gem-men work. In the way of getting at the gravel, sometimes the impediments of the trunks of trees and blocks of rocks are found, but almost invariably a sort of crust called "catooa," has to be got through. The illan commonly lie just under this catooa or crust which presents different appearances at different places, though at times it is entirely absent. It is seldom of greater thickness than a few inches, but its hardness varies from almost that of granite to sun-baked bricks. Just under this crust, which varies in colour also in different localities, is found the illan resting on a bed of clay of greater or less thickness, and of different colours even at short distances of space called "*Malawa*." I have seen it green, blue, grey, reddish, and at Balangodda, deep yellow; but the first mentioned colours are reckoned the most promising. It is said that under the stratum of clay, another bed of gravel has been found, richer than the one on the top, but of this I have no personal knowledge. The gravel being exposed, though under water, it is slowly and steadily scooped out with the mamotie above described, its concave form facilitating this, and being brought to the feet of the man engaged, is then deposited in the "Menik Wattia" (wicker basket) held under water with his feet. A sufficient quantity of illan being collected, he lays by the mamotie and washes it himself, or hands it over to another to wash, and goes on with the mamotie work. The washing of the illan is the next operation to be described, and is performed in this wise. The basket being held under water by the rim, the illan in it is rotated with a quick motion, by which the clay, now dissolved, and the lighter particles of stone are thrown out at the rim. From time to time the larger stones are taken up examined and rejected if they are not gems. The whole is now reduced down to what is called the "*Nabooa*," which is the heavy, thin sand, mostly composed of particles of precious stones, jet and the gems, the object of search, settled down by reason of their greater weight at the conical part of the

basket. The basket is then brought ashore and the *nabooa* examined, when the precious stones are easily recognized and removed. The foregoing is a brief account of gemming in water. Gemming on land is done in the following manner:—The place being selected, also in the dry season, the operation of pitting is begun, the pit being invariably of the square shape. The earth being removed to the level of the water, it becomes soft. From this stage commences the sounding of the pit from time to time to ascertain whether the illan is at a practicable depth, the "illan coora" in the hands of the experienced seldom misleading. The illan being found, the gem-men are obliged to re-double their exertions as now they have to contend against the influx of water which they are obliged constantly to bale out, and this the more as they get nearer the above described "crust," over which generally lies a bed of very permeable sand of greater or less thickness. The sand being got rid of, the illan is got at either after breaking through the catooa or not, if it do not exist. The illan is detached from the bed of clay with the crow bar and heaped up to be washed, but the larger stones that are found have almost all been discovered whilst breaking the illan from its situation. After collecting the gravel, its washings take place either in the pit itself if there be sufficient water in it or in an adjoining stream or pond, and this by the above described basket. It ought to be mentioned that the whole of the pit is not gemmed at once: the earth of only one-half is wholly removed at first, that of the other half being partly left constructed into a flight of steps to expedite the removal of earth and the baling of water. The first being exhausted of the gravel, the earth of the remaining half is thrown into the empty space, and the illan got out, thus saving a good deal of labour. I also omitted to mention that in gemming in the water, the sand of the spot on which the men with the mamoties stood, which spot is called "*Hetty Kattia*" is invariably washed, in order to detect any pieces of gem which might have fallen into the water in the act of transferring the illan from the mamoties to the washing basket.

The gravel in which gems are found represents the following appearance. It is a layer of stones of varying thickness and compactness, mixed up with an adhesive clay over a stratum of which it generally lies. The stones of this gravel are of different sizes, and among it are found interspersed large blocks of granite and quartz. The stones composing the gravel have evidently undergone detrition in water, some being smooth and round like pebbles, and others having their angular parts worn out. Gem-producing gravel has been found in hill-sides far away from streams, yet it presents the same appearance of having undergone attrition. This is the general appearance of the gravel, but there is another sort called et ady illan (elephant-feet illan) the gravel being found in circular detached patches of more or less extent like the print of elephants' feet (whence its name) with hardly any trace of it in the intervals. The gem-men call this the best sort of "illan" though deceptive. One may be lucky in getting a "pocket" of gems in a part of his pit, whilst his neighbour in the adjoining pit gets not a handful of satisfactory gravel, and is doomed to disappointment and loss. Another circumstance noticed by the gem-men is that when a large block of stone is found in the illan, you are sure to find a valuable gem or more in the gravel under it. The bulk of the gravel is composed, independently of the gems, of pieces of quartz (tirawana-gal) and granite of different degrees of hardness. In it have also been found pieces of copper-ore as at Neriella, and nickle at Gadawelle. The crust above spoken of as generally overlying the gem-matrix, presents curious appearances. In some places it looks like vitrified sand, the effect of a high degree of heat—at others like simple induration, the effect of a high degree of pressure long continued.

The right of gemming during the Kandyan Government was a Royalty, and it was exercised for a time by this government on its accession, but in the advance of a more liberal policy, it has not been acted upon for a long series of years. In the Kandyan rule, the services of the inhabitants of several large villages called "Agra-gan" were exclusively set apart for gemming purposes. There was also a body of hereditary gem-men called "*Meni-*

kan-karaya," and two *Mudiansas* (headmen)—those of Neriella and Karawitta to superintend the whole establishment, whose offices were likewise hereditary. This no doubt proceeded upon a perception of the good effects of a division of labour—the cause which has given origin to the caste system throughout India now perverted from its original institution. Though there is no caste of gem-men in the country, yet it will be found that only a section of the people understand and follow the occupation of gemming, and that their labour cannot be procured at ordinary wages. To constitute the *real gem-men*, a degree of experience and manual knack are required, which can only be acquired by long practice. The system of joint-stockery on a small scale is now being introduced into gem-searching speculations—the ordinary plan now is to gem in partnership—the gem-men and the land-owners having shares in the adventure.

We have now got to the period when the gems are supposed to have come into the possession of the gem-men. They dispose of their acquisition chiefly to the Moormen, the great trading body in the interior. But they seldom do so at any other time than at the parahare festival at the Saffragam Dewalle (Temple) in August—an annual fair when an immense deal of traffic is mixed up with an equal amount of idolatrous worship and immorality. Here the gem-men and the gem-buyers congregate and effect their bargains. Though this is the usual mart where the gem produce of the preceding year exchanges hands, yet the news of any valuable gem being discovered anywhere, sets all the chicanery, influence and humbug in the district in motion to get at the possession of it at a value far less than its real worth; and in this scramble unfortunately the poor gem-men in their ignorance are frequently duped by the designing as has been the case with the finders of a great many monster stones.

In speaking of the gem-dealers at the Parahare and other times, I should notice the deceptions that are often practised on the unwary, by selling to them counterfeit gems made of coloured glass, and a sort of stone that is called "*Kerinchy*." These latter are real stones found where gems are got, but they are not *precious*. They are of a far inferior hardness and very light as compared with the weight of *real precious* stones. There are red, blue and yellow *Kerinchies*, each sort easily mistaken for rubies, sapphires, and topazes. The best test to detect their nature is to cut them with the sharp angle of a real precious stone, when they will be found to wear away in powder.

The stones being now supposed in the possession of the country trader, are sold either cut or in the rough to the wearers or to the export speculators and diffused throughout the world.

In connection with those who earn their living by gemming, I ought to notice the stone-cutters of Ceylon—they are almost all Moormen, and carry on their trade in the low-country. Some of them, however, come up to Ratnapoora occasionally, and carry on their trade while business lasts, which is only for a short time, as very few of the gem-men get their produce cut. The simple instruments of their trade and the manner of carrying it on may be seen any day for the trouble of taking a stroll through Old Moor Street, Colombo, in the outer verandahs of which a great many will be found at work.

I have been induced to throw these cursory notes together in order to explain a subject which seems to be very little understood beyond the precincts of this district, and to draw attention to a calling which gives occupation to so large a number of its people, in the hope of advancing their interests in some degree. As I have already stated, there is great improvement observable at present in the mode of search for, and in the quality and quantity of yield of, gems, but there is, it strikes me, great room for further improvements, the methods used now being still in a great measure primitive.

It is to be hoped that with the advance of experience and the late spur given to exploration since the discovery of gems at Karangoda and Waralupe at depths unreached in former times, other similar gem-fields may soon be discovered in the district, adding to its value and importance. W. S.

P.S.—The monster gem found at Waralupe, together with the other smaller pieces found in the same pit, was sold here yesterday for £273.

REPORT ON THE GEOLOGY AND MINERALOGY OF THE SABARAGAMUWA DISTRICT.

(By Dr. Rudolph Gygax.)

I left Colombo on my tour in July, 1847, and my instructions required me to note, in a geological way, the features of the country, pointing out the peculiarities of the soil and climate; and when specimens of ores or valuable earth were found, to examine the locality with a view to ascertain the existence of any mines of value.

I started from Ratnapura, the capital of the District, and followed the course of the Walawé river for many miles, taking my way S.E. towards Balangoda; thence in the direction of the higher mountain zone overlooking the Bintenna country.

The *Geological formation* of the District appears to be similar to that known as the Cambrian and Devonian. The rocks are mostly granitic, interspersed by innumerable stratas of irruptive matter; viz., syenite, hypersthene, eupholite, and basalts in all their varieties. In the lower parts of the District the country chiefly consists of low undulating hills of quartz rock with limestone and basalt

The *Soil* generally is of a superficial character, bearing luxuriantly a few crops, but, on being worked, very rapidly wears out. It is believed that the heavy rains at certain seasons overflowing the country from the higher forest lands descend so charged with carbonic acid from the decayed vegetation, as to neutralize and wash out the little alkaline matter of this superficial soil. The red and brown soils, however, the produce of the Plutonic formation, are far more lasting, as they contain a good deal of rich alkaloids with more iron and manganese.

Rivers —The only considerable rivers here are the Kaluganga and Walawé, running from S.E. to N.W.; the small streams run from S.W. to N.E. The former river is navigable from Ratnapura to the sea at Kalutara, from which place there is a canal to Colombo, which will materially assist the transfer of ores and minerals to Colombo.

From the commencement of my researches, I felt convinced that I should succeed in meeting with mines of iron, tin, manganese, cobalt, nickel. and others; and even at the present moment, although but very partially successful, and meeting with many difficulties, I am confident of their existence both from the general features of the country and from the evidences met with. It must be borne in mind that all the specimens, or even larger quantities of metals hitherto collected, have been simply taken from the surface; no attempts having to this time been made at excavating, there being not one mason or stone-worker in the district, nor a stone building of any description except the ancient temples.

Iron.—The varieties of iron met with are six in number: viz., magnetic iron ore, titanate of iron, chromate of iron, iron with manganese, iron pyrites, and yellow hydrate and red peroxide of iron. The iron, however. in most of these is scanty, and the ores of little value except to extract the chrome and manganese. But there is another description of ore found in vast abundance, brown, compact, generally in the state of carbonate, though still blinded with a little chrome, and often with molybdena. This occurs in large masses and veins, one of which I believe extends for a distance of fifteen miles. Of this, millions of tons might be smelted, and when found near water-carriage and fuel it may be worked to a profit. I would lay particular stress on the very fine quality of the iron ore found in Ceylon; it is easily smelted, and so pure when reduced, as to resemble silver. The rough ore produces from 30 to 75 per cent—on an average fully 50 per cent; the iron wrought from it requires no puddling, and steel thus made cuts glass like a diamond. From calculations carefully made, the metal could, I think, be laid down in Colombo for about £6 per ton, and this, supposing the ore had to be brought thither for smelting and even prepared with English coal; but anthracite, being found on the spot, could be used in the proportion of three to one of English coal, and much cost saved.

Remains of ancient smelting furnaces are met with in all directions, precisely similar to those now in use amongst the natives. The Sinhalese never go to any trouble for the ore required; they seek a spot where the last rains have loosened the soil, and there break out a sufficient quantity, which is prepared in a couple of hours by the most simple means. None of their furnaces can reduce more than twenty pounds of ore, and this yields from seven pounds to ten pounds of good metal.

Manganese is also found in considerable quantity, though not in such abundance as iron, and the low price of the article does not hold out any inducement to work it.

Chrome is met with mostly as chromate of iron. It is found also of similar character to that of Baltimore and the Ural. It might cost, when brought to Colombo, three pence per pound, whilst the value in England is represented to be about nine pence.

Nickel, in the form of an arseniate, is found interspersed with many other ores in the alluvium of this district; it exists in small flat pieces resembling copper. It might be profitably exported to China, where it is of value as a colouring matter. Nearly in the same state and quantity, and in similar positions may be found *Cobalt*, another base of a fine colour and of value.

Tin.—The tin ores are also found in the alluvium just below the strata of precious stones. The locality most favourable for the existence of tin is decidedly in the eastern side of the district along the base of the high mountain zone, and especially near the Edelgassina Pass. To work tin mines here with success, it will be necessary, I anticipate, either to reduce the height of the rivers or to employ powerful pumps in each mine, so plentiful is the water and at so high a level. The position in which this ore has been met with is precisely similar to that of the ore in Saxony and Siberia, with tourmaline, white topaz, zircon, garnet, and corundum.

Titan and *Wolfram* ores are likewise found in the alluvium and in the iron and tin ores. They are used in porcelain manufactures as colours forming a rich brown, a steel green, and steel yellow.

Molybdena.—Next in abundance to iron exists molybdena in the Sabaragamuwa district. It is to be met with dispersed through all the varieties of rocks and throughout the alluvium in small grey scales, so nearly resembling plumbago that it is commonly taken for it. It is chiefly found in a state of bisulphuret in the Cambrian and Devonian strata. The ore was used in the Sixteenth Century for the manufacture of pencils, and at a later date to assist in working brass, bronze, and iron for statues, &c.; but it has been hitherto found so sparingly, and the price has been so high, that it has never been in general use. It might be obtained in large quantities in the neighbourhood of Kullurta, Godagamuwa, Bullutota, and Komdrugalla.

Tellurium.—The very rare and valuable metal called tellurium is also to be found in these vicinities. It has only hitherto been met with in Transylvania and the Ural mountains; it is used for chemical purposes only, and not long since bore the same price as gold in Europe.

Plumbago or *Graphite* is found chiefly in the southern side of Sabaragamuwa, in the Kukulu Korale. It is believed to belong o the same formation as the anthracite, viz., to the upper stratas of the Devonian formation. The principal mine is at Nambapana, and contains a large vein running from N.W. to S.E. The ore is pure and crystalline near the basalt, and compact and massive further from it. I believe that this vein extends to a distanae of forty or fifty miles towards the Bintenna country. The plumbago of Ceylon is pure and light, and now that a method has been discovered to purify and to compress it, the value will rise, especially as it is now required in the new process of smelting ores by galvanism. For this purpose it might prove a valuable export to South Australia.

Anthracite may be found in precisely similar situations with plumbago. Indeed, whilst the latter is the metallic carbon, the former is a hydrate of carbon. Just as plumbago is found near the basaltic eruptions, so is anthracite found. Both contain the same foreign substances, viz., quartz, alumine,

magnesia, titan, chrome, manganese, and iron. It is my opinion that this substance exists as abundantly as does plumbago. I recommend exploring the country for it near the Bentota river, half-way between Galle and Colombo, and I believe that it might be produced for 18s. the ton, whilst English coal cannot be laid down under 28s It is recommended to burn half anthracite and half coal, and now that large quantities of fuel are monthly required by the steamers touching at Point-de-Galle, this becomes a subject of importance.

Nitre has long been known to exist in Ceylon, and Davy in his account of the island describes it and its localities. I think that it exists in sufficient abundance to form an article of export, and that it would be good policy on the part of the Executive to encourage any undertaking of the sort by liberal terms of renting the spots found to contain nitre. The localities where the production is met with appear to be very similar to those in Brazil. In Sabaragamuwa there are about sixty caverns, varying in extent from 100 to 200,000 cubic feet. The abundance of wood to be found near these spots would appear to favour the lixiviation of nitre, and, by their being situated within short distances of water conveyance, the produce could be economically conveyed to Colombo for purification and shipment.

Kaolin is met with in great abundance throughout the district, varying in quantity from small strata to large rocks, and also in all degrees of purity. The cheapness of this article in Europe alone prevents it from becoming one of great value for export. The best earths yield from 40 to 70 per cent of the pure article. It makes a ware very similar to the Wedgewood, when well prepared; and a superior kind of tile capable of receiving all colours might be formed with it, especially as we have around such abundance of colouring materials for imparting any tint required. The coloured tiles found in the Moorish palaces in Spain are of this earth, and they are as fresh now as when made. The vicinity of anthracite to burn them, and navigable rivers for their conveyance, are all in favour of the manufacture, which would be infinitely preferable to the common porous bricks now in use in Ceylon for floors of dwelling-houses, both as regards appearance and healthiness.

Stratite, or French chalk, is found, but not very pure nor in great abundance.

Limestone is found abundantly.

Marble may be met with, but not of great purity.

So rich is the soil of many parts of Ceylon in precious stones, that despite the explorations which have been carried on for so many centuries, there is still an incredible quantity in Sabaragamuwa. They consist chiefly of the ruby, blue and yellow sapphire, chrysoberyl, topaz, tourmalin, spinel, garnet, cinnamon stone, and opal. Among-t all these the proportion of really valuable stones is comparatively small; still many are to be found of great brilliancy and beauty.

Great number of persons of very indifferent character employ their whole time in searching and gambling for precious stones, and the villagers are addicted to it to an excess which interferes prejudicially with the cultivation of their paddy and other lands. It is a pursuit in every way hurtful to the character of the people generally, and the district would benefit much could the search be kept as formerly in the hands of a licensed few. It is estimated that from this district alone, exclusively of a large demand within the island, stones to the value of £4,000 or £5,000 are annually exported, of which Government receives no share whatever.

From the low state of civilization of the natives, they cannot be expected to take any active part in the development of the mineral resources of the country. Their dislike to labour is painfully manifested, and is not likely to be overcome so long as they can obtain a living by searching or gambling for precious stones. Whilst this source of subsistence is left to them, they will not trouble themselves to undertake any mining operations, and it can only be by the aid of European industry, energy, and skill, that the natural wealth of this district is ever likely to be opened up. But it is not the people alone who prove obstacles to mineralogical researches and labour; the

country itself, from its very nature, offers impediments of a serious kind; the luxuriance of the vegetation, even amongst the most rocky parts of the district, renders correct and continuous examination of the face of the country tedious and difficult. But the greatest impediment to mining operations will prove to be the high level of the rivers, especially of the Kaluganga; and until this can be reduced, which it may be by blesting rocks at the various falls, we cannot hope to prosecute such operations successfully, or at least not to any practical extent. The most encouraging portions of this district for minerals appear to be the eastward, where there is great promise of piumbago, anthracite, and iron. As to lead and copper, these ores might be more reasonably looked for there than in the higher range of mountains; and tin ore, as has been before remarked, appears to be met with in quantity towards the higher zone near the Edelgassina Pass.

In the course of my explorations a number of resins and colouring articles have been found, of an entirely novel character, and some likely to prove of commercial value; but as yet sufficient time has not elapsed to allow of their being carefully analysed—a process which is now occupying my attention, and which in this country, where the means and appliances are not abundant, proves often a most difficult and tedious undertaking.

RUDOLPH GYGAX.

Colombo, 30th June, 1848.

GEMS IN SABARAGAMUWA.

(*Extracts form a Report made by Mr. F. R. Saunders, Assistant Government Agent, Ratnapura, to the Government Agent, Colombo, in* 1867.)

I have the honor to report, that so far as I can ascertain, regular gemming by pit-digging has never been freely and openly allowed on Crown land, though in remote districts very little attention has been paid to the mere washing of gravel or blasting of rocks in streams in search for precious stones.

There were some very valuable pits at Verulupe, which originally were claimed and held by the Temple, but when the land was "rejected" by the Temple Lands Commissioner and taken over by the Crown, the Government Agent called on his Assistant to stop the gemming operations, and to assert the rights of the Government.

These pits were afterwards sold, but close to the stream and adjoining the Assistant Agent's house there are still some gemming grounds which are considered valuable. A short time ago it was brought to the notice of my predecessor, Mr. Russell, that parties were again gemming in these pits and streams. He then issued the general order complained of by petitioners, and I have caused that order to be strictly enforced.

The question as to whether or not it would be advisable to derive a revenue by leasing the right to gem on Crown lands has before been brought to the notice of Government, and having read over the correspondence, I do not find the reasons urged against such a proceeding to be so convincing as to prevent me from expressing my opinion in favour of the suggestions made by Messrs. Mitford and Mooyart, and I most strongly recommend that the right of gemming on Government lands should be annually leased. In this I differ from the gentlemen aforenamed, that I recommend an annual lease and not a collection of revenue by license tickets.

It appears to me that to altogether prevent persons gemming on waste lands and in public streams, unless the Government intend to prosecute the search for gems themselves, is to conceal the resources of the country and to prevent the development of a trade, which is, I consider, capable of very great extension.

From enquiries I have made, I find that about £4,000 to £5,000 worth of gems are exported from the Sabaragamuwa district each year, and there can be no doubt that many of these gems are found in public streams and on waste lands It is calculated by those who are qualified to judge of such matters, that if any person bought the right to gem on Crown lands, and

could conduct his operations openly and not as at present by stealth, that he would realize at least £3,000 a year. When persons owning land on which gems are known to be found give gemmers the right to search, they exact a proportion varying from one-third to one-fifth of all the gems discovered. Taking this as a standard, the right to gem Crown lands in Sabaragamuwa should rent for about £700 or £800 a year.

This calculation, though in excess of the estimates made by Messrs. Mitford and Mooyart is under what I am led to believe the rent for 1868 would realize, and unless I have been greatly and purposely mis-informed, the figures I quote are under the general estimates made by persons possessing practical knowledge of the matter.

The agent here of the principal jeweller (Assena Marikar or the Gem Notary) tells me that the rent would fetch more than £1000 a year, and that he himself would be inclined to offer £500 a year for the right to gem in one stream alone (the Niwitigala River).

But the rent of the first year would probably be far less than would be obtained in after years, for it would soon become known what sums had been realized and what spots had produced stones of any value. I doubt not that offers would be made to buy some of the lands, whilst the value of the right to gem would not be diminished, for each year new pits would be sunk and fresh discoveries made.

In 1866 Mr. Birch sold 1½ acres of such lands (close to the Asst. Govt. Agent's house) in lots, and realized £420. One lot of 17 perches or 22 yards square fetched the sum of £117 15s, and I am told by a shareholder in this purchase, that the purchasers sunk two pits in the land (which is large enough to contain five pits). and in last year realized over £300, and cleared £200, by the gems discovered. Could these lands be sold or rented, now that their value is known, the 1½ acres would fetch nearly three times as much as they originally sold for.

That stones of very large value are occasionally found is established beyond doubt. Iddemalgoda Basnayaka Nilame who has given me much information on this subject, tells me that in one of his pits was found a sapphire that he sold for £800. and it was re-sold in India for £2,000. Another sapphire found in the stream near the Assistant Agent's house was the subject of dispute, and was sold for £200 to Iddemalgoda. He sent it to Colombo and sold it for £365, and it has probably since then fetched three or four times that sum in India or Europe.

Four months ago the Gem Notary sent to London to be forwarded to the Paris Exhibition,a sapphire found in the Veralupe pits. which,after much haggling he had bought from his fellow-shareholders for £650. This stone, which uncut, is said to be the size of a hen's egg, has been valued in Ceylon at £2,500, and it is impossible to guess what may be its value in the capitals of Europe.

All these stones were found in the Verulupe pits, whilst the temple claimed the land and before it was sold, and it shews of what wealth the Government was defrauded during the temple usurpation, though such wealth is, of course, valueless, if left in the bowels of the earth.

I beg therefore again to urge upon the consideration of Government, how desirable it is that some system should be adopted for developing the resources and trade of the district in this particular direction.

Solely as an experiment, I would ask permission to divide the district into parcels, and rent the parcels by public auction, the upset prices being fixed according to estimated value. Should the prices thus realized not be considered sufficiently good, the rent of the whole might be exposed in one lot at an upset price to be hereafter determined, and if the expectations of Government were not then realized, the rents might be withdrawn and persons most strictly prohibited from gemming on public lands for the future. My opinion is that leased in parcels the rents would fetch £1,000 : due notice will be required to be given to the jewellers of Galle and Colombo.

The rents should be sold in November or December to take effect from 1st January of each year, and the renters should be required to conform

to regulations guarding against destruction of timber or other Government property, whilst they are prosecuting their search for gems.

I am sir (Signed) F. R. SAUNDERS, Assistant Government Agent.

(*Note* 1881.)—The value of gems exported from Ratnapura has increased very much since 1867, and Government now lease lands at profitable rates, though there is no regular system or law to regulate the digging for gems on Crown lands.

PRECIOUS STONES AND GEMS.

(From "*Precious Stones and Gems,*" *by Edwin W. Streeter.*)

The amethysts of the Palatinate fairly rival in beauty those found in Ceylon or Brazil. It is not the geographical position which determines the difference, although it is acknowledged that India, Brazil and Ceylon have produced larger precious stones and in greater abundance than other lands. The ancients were wont to ascribe this pre-eminence to evaporation from the earth where precious stones are found—an evaporation obviously more intense in tropical countries. It is as if the sunburnt tropics were more favourable to the blossoms of the inorganic world, than the dark skies of the north.

But although precious stones are not limited to any defined geographical area, their distribution is in a measure circumscribed. They are not met with in all mountain ranges, nor in all formations of mountains. The most valuable are found in such ranges as are considered the oldest in the world; such as are composed of granite, porphyry, and mica-slate. Sometimes they occur imbedded in the mass of the rock; at other times, growing, as it were on the surface. When they are thus found in the very rocks where they were originally formed, they are said to be in their primeval bed. Many, however, are found far from their primal home in a *derivative* or secondary bed, in diluvial or alluvial soils, and in the gravels and sands of river-beds. This last mode of occurrence is the most frequent for the finer precious stones. Far removed from their native home by the force of heavy rains and rushing torrents, they have been loosened and carried onwards, rounded by friction against the débris with which they have been accompanied in their course. It is by their hardness and density that they are preserved, and many even retain traces of their original crystalline form.

In Ceylon, India, Brazil, Australia, California, the Ural, Siberia, and South Africa—from which countries the great majority of our precious stones are obtained—the most usual way in which they occur is in these derivative beds; and it is interesting to notice how various kinds of precious stones are found in the same locality, forming as it were a noble society of gems, still more illustrious by their association with gold and platinum.

The trade in precious stones is much more important now than formerly. Before the discovery of America, India was the great emporium. Pegu, famous for its beautiful gems of all kinds, received yearly a very large sum for its exports. So also did Ceylon, from which island we even now obtain a large portion of our coloured precious stones. During the dynasty of the Candian Rulers, the right of digging for precious stones was most jealously guarded as a royal prerogative, and the inhabitants of particular villages under the supervision of hereditary overseers were occupied in the search for gems. Under the British Government this monopoly was given up, and traders needed no "special permit."

A number of men are constantly employed in this exciting and precarious business; and the idle and disorderly adventurers who visit the villages are the cause of great immorality among the inhabitants. The results of their labours they sell to the Malays who come to Saffragam with cloth and salt, which they exchange for precious stones. At the yearly Buddha festival, there is a jewel market held in Ratnapura, whither those interested in jewels flock from all parts of Ceylon.

The position of the people in Saffragam is so much improved of late years that they are able to retain any stones they find of great worth for themselves. Now and then they are induced to exchange them for gold, which they can easily well conceal. The artificers who cut and polish the stones on the spot are generally Malays: but their work is so imperfect, and their knowledge of the art so faulty, that the stone positively loses by passing through their hands. Stones of smaller value, such as cinnamon-stone, garnets and tourmaline are cut and polished by ordinary workmen in Candia, Matura and Galla. Artistic and experienced workmen who cut rubies and sapphires live chiefly in Caltura and Colombo.

As a general rule, the rare gems are cheaper in Europe than in Colombo. Precious stones are brought from all parts of the world to London, both in the rough and also to be re-cut. In Ceylon the stock is so uncertain, that the price is largely determined at the moment by the rank and wealth of the buyers. The small Malay dealers do not buy rare and fine jewels, knowing quite well that the best and finest specimens are carefully held back by the rich traders, who can always ensure a high price for the best Ceylon stones from the native princes of India, who have an ardent passion for gems of conspicuous beauty or size.

It is quite impossible to judge accurately by the Customs' Register in Ceylon of the worth of the precious stones which are sent out of the island. Only a small part is sent to England. The rest are bought up by private hands, but these ultimately find their way into the English market. It is calculated roughly, however, that the value of the precious stones found in the island is £10,000 yearly.

It is said that the Dutch East India Company formerly received the rough stones in packets, sealed with their special seal. Those packets were sold by auction, without being opened. Often from 20,000 to 30,000 florins were paid for one packet, and the buyer was very rarely wrong in his purchase.

Sapphires and Rubies.

The prominent forms of crystallization are the six-sided prism and the hexagonal pyramid. The predominant colours are blue and red.

Sapphires are azure blue, indigo, duck's-neck colour, violet-blue, poppy-red, cochineal, carmine, rose-red to rose-white, milk-white, yellow white, french-white, lemon-colour and green. As a rule, the colours are pure and high. Sometimes a crystal is found exhibiting a variety of colours. The asteria or star sapphire shows, under the miscroscope, thread-like shafts directed towards the faces of the six-sided prisms, said to be spaces left at the moment of crystallization, and it is the reflection of light from these which give to the stone its star-like brilliancy.

The blue variety is called sapphire in its limited sense.

The red variety is the ruby.

Other varieties deserve notice, such as spinel, garnet, zircon, etc.

The finest rubies and sapphires are found in largest quantities in Burmah, at Mo-gast and Kiat-pyan, five days' journey from Ava

The small sapphires of Ceylon are well-nigh all of a rose-red. They can be obtained easily from old collections, as they were formerly used officially. They are so clearly crystallized that they are easily distinguished from spinel, which often accompanies them. Those found in Ceylon, Siam, and other eastern countries are remarkable for their colours. They are found like rolled pebbles in channels of rivers, and the colours run through green, red, yellow, and black. Bertolacci affirms that "the brilliancy and beauty of those in Pegu far exceed that of those found in Ceylon."

At the foot of the Capelan Mountain, near Sirian, a city of Pegu, and in the vicinity of Candy, corundum is also found in the detritus of granite, magnetic-iron, zircon, &c., all having been probably washed down from the granite mountains.

In Ceylon the sapphire is common, the ruby very rare; but the converse is the case in Pegu.

There are famous mines of rubies at Badakshan in Usbekistan, a part of Tartary. The mines were known to the Emperors of Delhi. They are near the Oxus, near Shunan. There is a belief among the natives that two large rubies are always near together: thus it is that the fortunate finder of the one hides it until he has found the twin like it; failing this, they will often break a large one in two. There is a belief also that the ruby is the product of the transformation of limestone, and that it is found in the form of pebbles. Near to the ruby mines a great quantity of blue felspar is obtained.

Corundum (proper) and Diamond Spar.

The mineral generally termed corundum is found in crystals with rough planes as a rule, and in individualized masses of a particular cleavage. The rhombohedral form occurs as in the former varieties, but here only in combinations The fracture is uneven. The colours, generally dull, are of greenish-grey, greenish-white, asparagus tint, oil, pearl grey, flesh or rose red, sometimes of a chestnut brown. It has only an inferior degree of transparency. The last-named variety comes from China, and because a peculiar bluish light occasionally plays upon it. Werner called it "Diamond Spar." It is said that some crystals found near St. Gothard, exhibit two colours, and that some of these are in dolomite, but more commonly they are found in mass. Some in Styria have grown in with the granite, and so firmly that it is difficult, if not impossible, to remove them without damage. The crystals may be from the size of a pea to that of a hazel nut, of a greenish-blue or duck's-neck violet. Some pieces display several colours. In Bohemia they are found embedded in pebbly masses of hercinite. In Rhodes, Sweden, and the Urals, they may also be found with tourmaline in schist, with platinum and magnetic iron ore. In Ceylon, China, and India, they are found in beautiful green crystals, possessing characteristic stripes, with black hornblende.

Pleonaste.

This mineral received the name of ceylanite from Romé d' l'Isle, who analyzed it with a number of others brought from Ceylon. Haüy, seeing its crystal was like that of the spinel, desired to give it a special position in the system of minerals, and named it *pleonaste*, which signifies superfluity. Further investigation shewed that it was in reality a black variety of the spinel.

The specific gravity of this stone rises from 3·5 to 3·8. It consists principally of alumina, and about 10 per cent of protoxide of iron. Its infusibility before the blow-pipe, and its formation with borax into an iron-coloured glass, are the surest indications of pleonaste. Acids have but little influence upon it. It is found in Russia and other cold climates, but it is also found in Ceylon, as well as in the dolomite region in Ratan.

Spinel, in consequence of its lustre, colour, and hardness, is used for personal ornament, and for objects of luxury; but it is only when the crystals are fine and large that they are considered gems. In cutting, it receives the same form as the ruby.

Spinal ruby or balas ruby varies in value according to its cut and colour.

In the inventory of the French Crown Jewels, in the year 1791, we find the following:—

One spinel ruby of	$56\frac{3}{4}$ carats	...	50,000 francs.
One ,,	$4\frac{2}{5}$ ..	...	300 ,,
One ,,	$3\frac{3}{4}$ ..	...	300 ,,
One balas ruby	$20\frac{2}{3}$ ..	...	10,000 ,,
One ,,	$12\frac{3}{8}$ ..	...	3,000 ,,

At the present time, small stones range from 5s. to 10s. a carat.
Medium stones of fair colour 20s. to 40s. a carat.
Large stones 60s. to 100s. a carat.
Specimen stones attain even a higher value.

The Cat's-Eye.

Much confusion exists concerning this very curious and valuable gem, a confusion arising partly from the ignorance of many in the trade as to its true nature, but principally from the mistakes of those who have written about it. In mineralogical treatises it is usually confounded with, and described as a particular variety of quartz, which somewhat resembles it, but which is of little or no mercantile value, although it has occasionally been sent to Europe by unscrupulous merchants as the true cat's-eye. This *chatoyant* quartz is found in Ceylon (also the home of the *true* cat's-eye) in large quantities, and occurs chiefly of various shades of yellow or brown. It is semi-transparent, and when cut in a convex form (*en cabochon*) shews a more or less defined band of light with a *silky* lustre, resulting from a reflection of the fibrous-like grain of the stone itself. or more probably from an intimate admixture of asbestos. This quartz cat's-eye, even when most perfect, cannot be compared for beauty with the real cat's-eye, for which it would not be mistaken, even by the uninitiated. It is at once distinguished by its inferior hardness and want of brilliancy.

Description of true chrysoberyl Cat's-Eye.	
Color—Various shades of yellow, brown, and green, rarely black.	
Ray—Iridiscent.	
Polish—Brilliant.	
Hardness—8·5.	
Specific gravity—3·8.	
Infusible and not affected by acids.	
Sometimes shewing a beautiful trichorism.	
Chem. Com.	80 alumina, 20 glucina, colouring matter—protoxide of iron.

Description of quartz Cat's-Eye.	
Color—Various shades of yellow and brown only.	
Ray—Dull.	
Polish—Dull.	
Hardness—6 to 6·5.	
Specific gravity—2·65.	
Melts with soda to a clear glass. Soluble in fluoric acid.	
Never trichoric.	
Chem. Com.	48 silicium, 51 oxygen, with a small amount of oxide of iron and lime.

The true cat's-eye is a rare variety of the chrysoberyl, of extreme hardness (in this respect being only inferior to the diamond and the sapphire), and is characterized by possessing a remarkable play of light in a certain direction, resulting it is supposed from a peculiarity in its crystallization. This ray of light, or "line," as it is improperly termed by jewellers, shines in fine and well-polished specimens with a phosphorescent lustre.

The cat's-eye comes principally from Ceylon, where it is found with sapphires, and is met with of various colours, ranging from pale straw-colour through all shades of brown, and from very pale apple-green to the deepest olive. Some specimens, much sought for by Americans, are almost black. The line, however, no matter what ground colour the stone may possess, is always white, and more or less iridescent. This lustre is most beautiful when seen in full sun-light, or by gas-light, when the line becomes more defined and vivid.

This gem is valued principally according to the perfection and brilliancy of the line, which should be well-defined, not very broad, and should run evenly from end to end across the middle of the stone. The colour does not influence the value much, some jewellers preferring one tint, some another. On the whole, perhaps, the most popular colours are the clear apple-green and dark olive: both of these form a splendid background, and contrast well with the line. It is quite impossible to give any satisfactory scale of values for this gem. Its estimation depends much on personal appreciation and taste: a ring-stone may be worth from £10 to £100, or even more; and there are large specimens at present in the market which are worth upwards of £1,000.

The cat's-eye has become more and more fashionable of late years in Europe, and its value has greatly increased.

In India it has always been much prized, and is held in peculiar venera

tion as a charm against witchcraft, and is the last jewel a Cingalese will part with. The specimens most esteemed by the Indians are those of a dark olive colour, having the ray so bright on each edge as to appear double. It is indeed wonderfully beautiful with its soft, deep colour, and mysterious gleaming streak ever shifting, like a restless spirit, from side to side as the stone is moved; now glowing at one spot, now at another. No wonder that an imaginative and superstitious people regard it with awe and wonder, and, believing it the abode of some genii, dedicate it to their gods as a sacred stone.

Star-stones, or Asteria.

The Orientals had, and still have, a deep veneration for star sapphires. The localities of star-stones are the same as those of other sapphire crystals.

When light shines upon these stones, stars of six rays are seen, an appearance which attracts much attention and gives proportionate pleasure. This may be termed its speciality, and is more observable when the stone is convex. The colour is a greyish-blue; occasionally blue and red specimens are met with.

The star-stones, according to their colour, are designated star ruby, star sapphire, or star topaz.

Only of late years have they been of any value in England. In Ceylon, but a few years back, they could have been purchased for a few shillings, as the natives had but little regard for them. The finest star ruby I have seen was valued at £200, and is in the possession of a private gentleman, who obtained it from a noted collection. If a pair of these stones could be obtained, their value would undoubtedly be largely augmented. The price of these gems is mainly determined by their size and quality; small star sapphires range from £2 to £10; large sapphires £10 to £100. Star rubies obtain higher prices, but star-stones, of a secondary rank, are of little or no value.

The River Sangaris (according to Plutarch) produces a gem called aster, which is luminous in the dark, and called by the Phrygians "Ballen," "The King." A gem called "Asterites," found inside a huge fish called "Pan," from its resemblance to that god, is also described by Ptolemy hephæstion. This stone was a potent love-charm, and when exposed to the sun shot forth flames. It was used by Helen of Troy for her own signet, and to it she owed all her conquests. Helen, however, was not of human origin simply, and her beauty was as great at seventy as at seventeen. The term asteria has been used by different authors in various senses at various times; but Pliny understood by it the same gem that we do at present. The star sapphire is also known under the title of astrapia (lightning stone), from its supposed action in a colourless or an azure ground, sending out, as it were, rays of lightning diverging from the centre.

Asparagus or yellow-green chrysolite was known in very early times to the people of Ceylon and Brazil. In Ceylon it was found in the sand of the river in company with tourmaline, spinel, and sapphire. On the east side of Borneo also, it is found in the river sand, and in flooded lands with crystals, gold dust, diamond, topaz and emerald. In Pegu it is found amongst pebbles and loose river sand. In Brazil, pieces of this chrysoberyl of the size of a hazel nut, and of yellowish-green colour, are sometimes met with while washing for diamonds. Of late years it has also been found in Connecticut, North America, in well-formed tables and prisms, with tourmaline, garnet, and beryl, in the granite strata; and at Saratoga and Greenfield in New York State, in regular twin crystals with tourmaline, garnet, and apatite.

The Garnet, Carbuncle, Jacinth, and Cinnamon Stone.

The garnet or carbuncle was a great favourite with the ancients. Several antique garnets have been found in Roman ruins, some being round, and some cut; the latter receiving the name of "Garnet Plates," the underside of which is ground convex, to give them a more perfect transparency. In former days it was very frequently engraved, and several beautiful specimens are now to be seen in Paris, Turin, Rome, and St. Petersburg; among which

is the grand masterpiece of art, the representation of "Sirius," engraved on the celebrated Marlborough garnet. The small degree of hardness possessed by this stone renders engraving on it comparatively easy.

The word garnet, or, as the Germans call it granat, owes its origin to the similarity in colour to the blossom and kernel of the pomegranate, a fruit of Southern Europe; it is not a name of ancient date. Pliny calls it "Carbuncle" from "Carbo," a live coal; both names are derived from its bright red colour. According to some authorities, however, it is thought that the origin of garnet is "Granium," a grain, because it is so often found in that condition. The precious garnet is sometimes called "Almandine," from the city of Alabanda, in Carien. Its colour is blood-red, cherry, or brownish-red, which, unlike the American amethyst, gains nothing by candle-light. On the contrary, it assumes an orange-tint, which detracts from its beauty. The crystals are almost always embedded in the rock singly. Its specific gravity is from 4 to 4·2, and its hardness is 7·5. It possesses a bright lustre, and is transparent. It occurs very frequently mixed with a variety of other stones, and the places where it is found are so numerous, that only a few of the most important can be mentioned.

In Hindostan, garnet is abundant in the débris of mountains; and in Ceylon it occurs everywhere in gneiss, particularly at Trincomalee and at Adam's Peak.

The jacinth, sometimes called hyacinth, is an orange-red variety, it differs in some respects in character from the deep red garnets, and is considered by lapidaries as a distinct stone. This is a mistake, as its crystalline form and typical composition are identical with that of the other garnets. Its chief difference, besides its peculiar colour, is a lower specific gravity, and the presence of 30 per cent of lime in lieu of protoxide of iron. The specific gravity is 3·65. It is known to mineralogists as the essonite or cinnamon stone.

Jacinth, or cinnamon stone, comes almost entirely from Ceylon, where it is found in large pieces in the strata of rocky mountains; these stones are generally finely coloured and transparent. They are cut thin on account of the depth of colour, with a pavilion-cut below and a broad table above, bordered with small facets.

Rock crystals are found in a variety of forms, sometimes of extraordinary size. Their colour varies from pure white to greyish-white, yellow-white, yellowish brown, clove-brown, and black. They possess double refraction and transparency. The electricity obtained by friction lasts about half-an-hour, rarely longer except under very favourable conditions. Before the blow-pipe many coloured crystals lose their tints. The frequent admixture of chlorite, asbestos, rutile, iron pyrites, gold, and radiolite in the crystals is very remarkable. The green colour of the last is like a blade of grass inclosed in ice. The liquid or gaseous contents, which move as you turn the crystal, are very interesting.

Ceylon affords it abundantly, and the natives use it for ornamenting their temples.

The Tourmaline.

Tourmaline, known in Saxony as "Schorl," from the name of a village where it abounds, is mainly composed of alumina, silica, and boracic acid, although there are specimens which contain a small quantity of iron and manganese. The crystallization is rhomboidal: its cleavage is imperfect, and its fracture conchoidal. It is very brittle. Its hardness is 7 to 7·5, and its specific gravity 2·9 to 3·2. Tourmaline is rarely found of pure-water. Its colours are very varied, consisting of shades of greys, yellows, greens, blues, and browns; they all have a tendency towards the darker hues, even to black. A black or red kernel is not infrequently found in the midst of the stone.

Tourmaline possesses double refraction. Some specimens polarize light perfectly, and by the aid of the polariscope it is easy to detect the pure gem from the yellow and green specimens.

Tourmaline, in common with other precious stones, developes electricity

under friction, and is a mineral of the greatest interest from a thermo-electric point of view. Its dust is attracted by the magnet.

The Dutch introduced tourmaline, somewhat more than a century ago, into Europe from Ceylon.

The yellowish-green tourmaline (Ceylon chrysolite) is very like aqua-marine, and is found in the river-beds of Ceylon and Brazil. Colourless tourmaline occurs very seldom in pieces worth the cutting and polishing. The most beautiful specimens are found in Elba and in dolomite mountains. Brown tourmaline is a variety not used for ornament. Ceylon and Switzerland yield a fair supply.

The value of the tourmaline depends upon the colour, quality and size of the specimens; one of exceptional colour and purity, of five carats weight, would be worth £20.

The Zircon, Jargoon, or Hyacinth.

The zircon, jargoon of lapidaries, and hyacinth, are all varieties of the same stone. Its name in Greek is "Uakinthis," in Latin "Hyacinthus," in German "Hyacinth," and "ein breuneder jacinth," and in French "Jacinthe la belle." We apply the term hyacinth to transparent and bright-coloured varieties; jargon to crystals devoid of colour and of a smoky tinge, which are occasionally sold as inferior diamonds. Anselmus Boetius gives the following description of this gem:—(1st) "There are some that flame like fire, or are similar in colour to crimson or to natural vermillion, these the French jewellers call 'Jacinthe la belle,' and these they esteem the best. (2nd) Those with a yellow-red colour. (3rd) Others which are like unto amber, so that they can hardly be distinguish d from it, but by their hardness. These are of no great value by reason of the atoms they contain, and the multiplicity of small bodies which are in them, which do hinder their transparency and translucency."

Little grains of zircon are found in the valley of the Iser, in Bohemia; and small violet-blue crystals are obtained from the gold sands of the Ticino, and also from Vesuvius. It is obtained from Ceylon, which is one of the richest beds of natural wealth in the world, and also from Pegu in the river sands.

PRECIOUS STONES IN CEYLON.

(From *Ribeyro's Ceylon, by George Lee.*)

The precious stones which are most remarkable in Ceylon, and which the Moors and Indians most prize, are the *cat's-eyes*. They are scarcely known in Europe. I saw one on the Prince of Uwa's arm, when he came to visit us, of the size of a pigeon's egg. It was quite round and of the form of a large musket-ball. These stones are heavier than other precious stones; they are never worked up, but are only cleaned off. It seems that nature has concentrated in this one stone the finest and most lively colours which light can form; and that those colours contest with each other which shall produce the greatest effect. One colour is more prominent to view than another, according to the light in which the stone is held: and if its position is changed, another colour strikes the eye to greater advantage; on this account the stone is called a *cat's-eye*, as it has rays opposed to each other which create that variety in its appearance; as we see the eye of the cat itself change in brilliancy and effect, as the animal turns or removes it. These rays in the *cat's-eye* are never of an even number; there are three, five, or seven of them; these lines of light are called, *betas* and the price of the stone increases according to the number of those *betas*. The rubies are the finest stones after the cat's-eyes, then come the sapphires and topazes. The Moormen attach high value to the topazes of Ceylon, because some of them are very large These four precious stones are the most common in Ceylon; we have already spoken of some others, but they are of smaller

value. There are some mountains on the island from which white, green, or red crystal is procured; and the native workmen cut it well and polish it for crucifixes, images, crosses and other emblems of religion, by means of two wheels and emery and solder.

Addition by the French Editor.

ON PRECIOUS STONES.*

Edward Barbosa, who has published a treatise on what he saw, most remarkable in the East Indies and of their chief articles of trade, dwells particularly on the precious stones of the country. He gives us their peculiar marks, the places where they are found, and their respective prices and values. He begins with the rubies and he states that the finest and best are found in the Pegu river, and that there are others in the mountains beyond that river, but of an inferior quality; yet he says that a ruby from Pegu, perfect in quality, weighing twelve carats, was only worth in his time 150 golden crowns, and he values one of Ceylon of the same weight at 200 crowns. He says also that there are some in Ceylon weighing 16 carats which are worth 600 crowns; he does not say that there are any so large in Pegu; but it does not appear that fine rubies are so common in Ceylon as there. They are assayed in this way:—when a ruby of considerable size is brought to the king, he sends for his jewellers, who tell him to what degree the gem can stand fire, and how long; these men are seldom in error; the ruby is then thrown into the fire and left there as long as they have stated, and when it is taken out, if it has borne the fire well and is of a more lively colour, it is esteemed much more highly than those of Pegu.

Two sorts of *sapphires* are also found in Ceylon; the better kind are hard and of a fine deep blue, and are greatly esteemed; but the pale blue ones are little thought of, yet they are valued more highly than those which are obtained from the mine near Mangalore, or from Capucar in the Kingdom of Calicut.

Fine *topazes* are also procured from Ceylon; when they are clear and brilliant, they are sold for their weight in gold; but when they are whitish, the Singhalese use them to make false diamonds.

Barbosa says that the Singhalese know so well how to bleach sapphires, topazes and other hard stones, that many people take them for the finest diamonds, and that a person must be an adept in this matter not to be deceived by them; and that time alone shews whether, stones thus prepared are false or not, as they lose their whiteness by wear and resume partially their natural colour. The jewellers, however, say that topazes well bleached always remain white.

Barbosa does not mention the cat's-eyes found in Ceylon: he only says that the Singhalese can counterfeit that stone perfectly.

GEMS IN CEYLON.

The following is from a European Colonist with a long experience of Rakwana. He writes in May 1881:—

From time immemorial the Island of Ceylon has been noted for its precious stones, and the greatest portion of the island, especially the southern half, is pockmarked with the pits dug by ancient and modern gemmers. With few exceptions these pits are of the most superficial character, as without adequate appliances it is impossible to keep them clear of water when they are deeper than 10 or 15 feet. The only gemmer who has used a pump driven by horse-power is Mr. C. M. C. Hassena Markar on the gemming ground near Ratnapura. The Sabaragamuwa district has always been considered to be the richest field for gemmers. In the neighbourhood of Awisawella, Ratnapura, and Balangoda, there were formerly extensive gemmings.

* From Ramusio—vol. I, fol. 321.

but these have been in a great degree abandoned for other fields in the same district, and of these by far the richest has been North Rakwana, which now supplies the chief part of the sapphires, cat's-eyes and other precious stones sold in Ceylon.

The richest fields are situated on a plateau at the base of the Surya-kanda and Kabaragala mountains, on the top and sides of Rakwana, and extending from the Springwood estate on the east to the Martinstown estate on the west. During the last ten years, the gemming by natives in this locality has been of the most extensive character, and auction sales of large quantities of rough gems are not uncommon. It is stated that ninety thousand rupees worth of rough gems were sold at one of the auctions, the result of gemming on one of the estates at the foot of the Kabaragala mountain.

The deepest gemming pits in the island are those which were washed by the Gem Notary, until they could no longer be kept clear of water. These pits are upwards of 100 feet deep.

LIST OF GEOLOGICAL AND MINERALOGICAL SPECIMENS FROM CEYLON AT THE MELBOURNE EXHIBITION.

(Collected and Exhibited by A. C. Dixon, Esq., B. Sc., F.C.S., Colombo.)

1. Dolomite from Wattegama.
2. Dolomite from Wariapola.
3. Dolomite from Wilson's Bungalow.
4. Dolomite from Wellawa.
5. Dolomite from Kurunegala.
6. Dolomite from Alu-Wihara.
7. Dolomite, with blue spinel, from Wariapola.
8. Limestone from Jaffna.

Nos. 1 to 7 furnish examples from country limestone which occurs in beds in the gneiss. They vary much in texture, colour and composition, but they all contain carbonate of magnesia. It is used as building stone, when burnt forms a very useful lime for estate purposes or for building. These dolomites occur in somewhat parallel beds which traverse the gneiss in a northerly direction I have indicated their position on a rough geological sketch map sent along with the collection.

In the various specimens we have accidental minerals such as magnetite, pyrites, spinel, phlogopite, wollastonite, chrysolite and zircon. No. 8, Jaffna lime tone, furnishes a very pure lime. The formation occurring in the north is probably cretaceous and equivalent to the Pondicherry beds of India.

9. Mica in nodules found in the valleys of the Dimbula district.
10. Gneiss decomposed forming the bottom layer of the gem pits.
11. Magnetite, shewing a peculiar cleavage occurring locally on Harmony estate, Pussellawa.
12. Limonite (Botryoidal) occurring under the cinnamon sand in the Negombo district.
13. Iron conglomerate still in course of formation in various ravines of the island. It occurs in very extensive patches; such a deposit subjected to decay would form a rock resembling our laterite.
14. Iron ore from Nuwara Eliya.
15. Gneiss containing nodules of iron from Kottagala.
16. Gneiss (garnetiferous) from Horape quarry, near Mahara.
17. Gneiss (ordinary) from Mahara quarry. the stone from which is used in the construction of the Colombo Breakwater.
18. Gneiss from Mahara.
19. Gneiss with green felspar.
20. Laterite or cabook from Colombo, quarried very extensively for building purposes

CASE II.

21. Graphic granite from Balangoda, so called because the quartz, one of its constituents, stands out prominently resembling an inscription.

22. Syenitic gneiss from Hokawela, Matale Railway. The ordinary blue gneiss can be seen passing into this altered variety. It closely resembles Peterhead granite.

23. Jasper (crude) from Balangoda, an impure opaque form of silica.

24. Gneiss from Petiyagalla, with molybdenum.

25. Sandstone from Talpitiya, a recent breccia taken from 300 yards from shore at a depth of 25 feet. The particles of sand are held together by a calcareous cement.

26. Plumbago found in veins in several districts. Large specimens are sent from a commercial point of view.

27. Quartz (crystalline) with plumbago from Diatura.

28. Hornblende rock from Madola, Saffragam.

29. Mica found in considerable quantity in pockets in the decomposed gneiss.

30. Hornblende rock from Watte gama, Matale Railway.

31. Decomposed gneiss from a depth of 20 feet from Labugama. The felspar of our rocks, when subjected to action of water, soon decomposes.

32. Kaolin from Maturata, also found largely at Nuwara Eliya. It makes a very fair porcelain.

33. Gneiss decomposed from Pallekande. The green colour is due to epidote and chlorite.

34. Iron pyrites from Nambapana.

35. Smoky quartz from Medakanda, Balangoda.

36. Calcareous Tufa (Panugal of the Sinhalese). This is a deposit of carbonate of lime from the hot springs of Bintenna. It is burnt by the natives of the district and used to chew with their betel.

37. Sandstone from Pamunugama, a recent formation occurring on the sea coast from Negombo to Mount Lavinia. The black crystals are magnetic iron. The particles of sand are tel together by calcareous matter.

38. Sandstone from Pamunugama, another variety.

39. Gneiss from the top-most rock of Adam's Peak. It is very quartzose and agrees in the main with the common rock of the island It is upon this that the sacred foot print is placed to which so many thousands of pilgrims resort annually.

40. Rock crystal from Ratnapura.

CASE III.

41. Sapphire (crystals) Nil-padiyan.
42. Sapphire, Sudu-nil.
43. Sapphire, Otu-nil.
44. Sapphire, Nil-kanti.
45. Star Sapphire.
46. White Sapphire.
47. Ruby, Ratu-keta.
48. Amethyst, Oriental.
49. Corundum.
50. Topaz.

Nos. 41 to 49 represent the sapphire family which crystallizes in the hexagonal system. The numerous members of this group are divided according to colour, hardness &c. Thus, when blue it is called sapphire; red, ruby; purple, amethyst; when it lacks transparency and is of dull colour it is known as corundum.

No. 44 is partly blue and partly red.

No. 43 partly blue and white. The Sinhalese can by heating such with lime distribute the colour evenly through the stone, or with greater heat can discharge the colour and so imitate the white sapphire.

No. 45 on account of lamellar structure when cut in convex form shews a star of 6 rays.

No. 48 is the oriental amethyst, so-called in order to distinguish it from the quartz amethyst.

Green corundum is known as the oriental emerald and yellow as topaz.

51. Spinel (crystal).

52. Spinel—a very abundant mineral, crystallizes in the cubic system generally in octahedrons or duodecahedrons, specific gravity about 3·5 while the ruby is 4, and the garnet 3·8.
53. Garnet (Kurundu kal).
54. Cinnamon stone (Essonite) a kind of garnet.
55. Garnet.
56. Tourmaline, Pachcha-toramalli.
57. Tourmaline, Peni-toramalli.
58. Tourmaline.

Tourmaline is very abundant, both crystalline and massive. It is of various colours and crystallizes in the hexagonal system.

59. Peridot of Ceylon.
60. Chrysoberyl, the true cat's-eye—an ordinary kind of cat's-eye is quartz when cut *en cabochon*.
61. Pleonaste, a kind of spinel.
62. Zircon, very abundant in Ceylon, crystallizes in the terragonal system; disregarded by the Sinhalese, except the white variety which is cut and sold as Matura-diamond; often, however, Matura-diamonds are rock crystal.
63 Moonstone, a pearly variety of felspar, quartz, and selenite are often cut and sold as moonstone.
64. Steatite or soapstone, a massive variety of.
65. Quartz (teruwana).
66. Quartz (crystal) palingu.
67. Refuse stone.
68. Gem sand.
69. Unassorted gem stones.
70. Gem sand from Pelawatta, Kalutara.
71. Cinnamon Garden sand.
72. Cabook gravel from Colombo.

GEOLOGY AND MINERALOGY.

(From *Ferguson's "Summary of Information regarding Ceylon."*)

The Geological formations met with in Ceylon are of the Palæozoic, Mezozoic and recent age. The greatest portion of island consists of ancient sedimentary beds, doubtful deposited sea or lake, metamorphoses have obliterated all traces of fossil remains. Mountain ranges formed of primary and metamorphic rock. Principal rock, gneiss, with beds of laterite (locally named "cabook") and dolomite, according to some authorities,—described by others as crystalline marble or primary limestone. Plenty of iron, but no trace of coal. Manganese. Gold and platinum, but in such small quantities not apparently worth gathering. Molybdenum, Cobalt, Nickel, Tin, Copper and Arsenic also occur. Plumbago, the only mineral of commercial importance. Cretaceous beds of Jaffna of Mezozoic age. Nitre in caves. Salt forms naturally, and is also manufactured in sufficient quantity at Puttalam, Jaffna, and Hambantota, to supply the consumption of the Island. Calcareous Tufa met with at Bintenne deposited from warm springs. Hot springs at Trincomalee and other places, but no direct evidence of present volcanic action, and earthquakes seldom perceptible. Greenstone, however, underlies gneiss at Kadugannawa, and with vitrefactions is observed in fissures of rocks at Trincomalee. Spring of Sulphurretted Hydrogen similar to Harrowgate water occurs in Puttalam district. Large tracts of alluvium occur in the Nuwara Eliya and other districts. Process of slow upheaval believed to be in operation on western coast, with compensating disintegration of mountain ranges. Recent formation a breccia formed of particles disintegrated rock held together by calcareous and ferruginous matter near Negombo and along coast. Gems abundant especially about Ratnapura ("city of gems") but, with exception of blue sapphire and ruby, of slight value. A flawless sapphire is rare and good rubies are excessively scarce. Zircon or "Matara diamond," and amethyst, common. Chrysoberyl (or "cat's-eye,") not uncommon, curious, and

often prized. Moonstones (very beautiful form of "adularia") and "cinnamon stones," (brown garnets) common. Spinel and tourmaline very abundant. Many rocks and river beds sparkle with red garnets, beautiful but intrinsically valueless. Ceylon celebrated for fine pearls.

SILVER CASKET AND PRECIOUS STONES EXHIBITED AT THE MELBOURNE EXHIBITION BY MUDALIYAR P. B. GOMES.

(*From the "Ceylon Observer."*)

This highly finished Casket (No. 15 in Supplementary List in Catalogue) made in Ceylon under the supervision of Mudaliyar Gomes is of pure silver, and can be unscrewed in pieces. It stands on four Ivory castors and measures $7\frac{1}{2} \times 5\frac{3}{4} \times 4$ inches. The carving is specially worthy of attention, as on the lid and sides of the casket are depicted a variety of the fruit-bearing trees and vegetable products of Ceylon. It also shews very well-executed figures of a Kandyan Monarch and his Adigars (Ministers). Among the products carved are the Jack tree, the Bread Fruit tree, Cinnamon, Coffee, Gamboge, wild Breadfruit, Cocoanut palm, Plantain, Kittul palm, Palmirah, Arecanut, Wild Date palm, Jambu tree or the Rose apple, Tobacco plant, Ash Gourd, Pumpkin, Long beans, Betel creeper, Pepper creeper, Cucumber, Carville, Sweet potatoe; besides these, an Elephant Kraal is depicted, and Native carvers at work.

The Silver Casket which is valued at 500 rupees (£50 sterling) contains a number of the precious stones of Ceylon cut and uncut, the list being as follows:—

No.	1	Ruby cut 1, uncut 6	value R120
,,	2	Sapphire cut 1, uncut 2	40
,,	3	Topaz cut 1, uncut 5	120
,,	4	Cat's-eye cut 1, uncut 5	120
,,	5	Starstone cut 4, uncut 1	20
,,	6	Amethyst cut 3, uncut 1	15
,,	7	Aquamarina cut 1, uncut 7	5
,,	8	Tourmaline cut 2, uncut 4	5
,,	9	Moonstone cut 3, uncut 9	25
,,	10	Cinnamon stone cut 4, uncut 11	5
,,	11	White Sapphire cut 4, uncut 4	5
,,	12	Coins Ceylon, Gold 1	30
		,, Silver 9	
		,, Copper 14	
		,, Goldstone 1	

or about 500 rupees' worth of gems and old coins.

PLUMBAGO

(The only Mineral of Commercial Importance largely exported from Ceylon).

THE CEYLON TRADE IN PLUMBAGO.

(From the *Ceylon Directory and Handbook of Information for* 1881.)

Ceylon at the present time is the chief source of supply of plumbago or graphite. Most of the product of this island is carried to England for distribution or manufacture, but quantities are shipped direct to other countries, especially the United States It has various uses. Much of it is used for making pencils, whence its name graphite. The graphite for pencils is obtained chiefly from Siberia.* The great consumption of the mineral, however, is for the manufacture of crucibles used in chemistry and

* Ceylon plumbago is used to mix with Cumberland graphite to make good pencils, the latter being too hard by itself.

metallurgy. It is practically infusible. There appears to be no material in nature fitted to compete with plumbago in the manufacture of crucibles for melting metals, and no source of supply with superior advantages to this island. Our plumbago (a form of carbon) resists the action of fire better, perhaps, than any other substance except asbestos, and accordingly the demand for it has increased with the increased demand for the precious metals in the shape of coin, steel, &c.

The quinquennial Export of PLUMBAGO from Ceylon has been as follows :—

5 years	ending	1841	average annual export		cwts. (can't be given)
do	...	1846	do		,, ,,
do	..	1851	do	13,410	,,
do	...	1856	do	13,950	,,
do	...	1861	do	37,530	,,
do	...	1866	do	57,295	,,
do	...	1871	do	124,714	,,
do	...	1876	do	137,474	,,
3 do	ending	1879	do	114,671	,,

It will be observed that, notwithstanding a heavy export last year (162,000 cwts. in 1879), the average has latterly diminished, but this is probably owing to the fact that the crucible-makers, both in England and the United States, made extra efforts to lay in stocks in view of the announcement that the Ceylon royalty was to be collected by the Customs instead of at the pit's mouth, the latter system being found to lead to the export of much of the mineral on which no royalty had been paid. Complaints having been made that the original royalty of R10 per ton bore very heavily on the lower qualities, the rate has now been reduced to R5 per ton. The maximum export of plumbago seems to have been in the twelve months ending 30th Sept. 1869, when nearly 200,000 cwts. were exported, and again, the commercial season ending with 30th Sept. 1880, is likely to shew a quantity very nearly equal, the shipments to 19th August aggregating 183,000 cwts.

The greater proportion by far of the plumbago which goes from Ceylon is used by two great crucible-making firms: one in England, the other in the United States of America*; and if only a certain number of crucibles are wanted by the melters of metals, it is clear that enlarged exports may result only in cheapening the raw product to the crucible manufacturers, in glutting the market, and in loss to traders and diggers. All the evidence within our reach seems to shew that from no other part of the world can better or cheaper supplies of this form of carbon be obtained than from the mines of Ceylon. We can supply all qualities for all purposes, from a crucible to a pencil, the exception, perhaps, being the so-called "black lead," requisite for the finest kinds of drawing pencils. Here we yield the palm to Cumberland; but it appers Ceylon plumbago is used to mix with the fine Cumberland description.

It is impossible to get the exact number of plumbago mines and pits in Ceylon, but it is usually reckoned at about 400, besides 230 gem and 30 iron quarries.

PLUMBAGO MINE AT KEGALLA.—Mr. C. Matthew's mine in this neighbourhood, constructed under the direction of a Cumberland miner, is said to be unique so far as Ceylon is concerned. A regular shaft has been sunk to a depth far below that ever attempted by the Sinhalese. A steam engine, pumps and other apparatus have been erected, and altogether capital and enterprise freely expended. Many years ago, two Cumberland miners, friends of Mr. Robert Dawson, went in for regular mining, but did not succeed. They afterwards went to Bombay and made and lost a great fortune.

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* This American firm, the Dixon Crucible Company, Jersey City, New York, has for years back competed with the Battersea Crucible Company of London for our plumbago, and the result is that the export has risen.

In lieu of a royalty formerly levied at the pit's mouth, the Government now collect a small revenue from this plumbago in the shape of a Customs duty of R5 per ton. With this exception and a royalty of R200 on each elephant caught in the Government forests and sent abroad, there are no export duties levied in Ceylon. The export of plumbago, which gives employment to a considerable number of the natives of Ceylon, has been for a series of years back :—

	Cwts.		Cwts.
1850 ...	23,823	1875 ...	149,938
1860 ...	5,660	1878 ...	84,635
1865 ...	40,144	1879 ...	162,495
1870 ...	85,249		

Last year's export was valued at £160,000.

THE CEYLON PLUMBAGO INDUSTRY.

(From the *Ceylon Observer*, 12th August 1880.)

A visit we paid the other morning to the Plumbago Store of Mr. W. A. Fernando, at No. 1, Brownrigg Street, Cinnamon Gardens, has given us a new and enlarged view of the ramifications of the Plumbago Industry of Ceylon. We were, of course, familiar with the rise and progress of our export trade in this the only mineral of any importance of which Ceylon can boast. We knew from the official returns that, while thirty years ago (1851) the total export only equalled 13,410 cwts., last year the quantity shipped had mounted up to no less than 162,000 cwts. But although it was quite evident that the digging and mining which brought so large a quantity of plumbago to light, as well as the carting, preparation, and picking, must give employment to a great number of people, we had no idea before the inspection of Fernando's store of the very considerable influence which the industry now has on the welfare of many thousands of the population in the Western, the North-western and Southern Provinces. The favourite mining districts are at present in the neighbourhood of Kurunegala, Awisawella, Ratnapura and Kalutara, and in the Pasdun Korale. Mr. Fernando, a most intelligent enterprising Christian Sinhalese of Moratuwa, whose father and family have for many years been connected with "plumbago," was unable to tell us that the seekers after plumbago were guided by any better indication than the appearance of the surface soil, or of pieces of the mineral cropping up through fissures in the rock. Here is just the case where a Government Geologist might afford valuable aid in developing an important industry Mr. A. C. Dixon, if employed by Government during the Academy vacations, might be able to point with much confidence to undeveloped Crown lands likely to prove of great value for their beds of plumbago, and his advice to private proprietors might also save much time and money in trial pits, surface digging, and general exploration. Plumbago mines have been sunk in Ceylon several hundred feet in depth, and some are worked with all the appliances of an English mine, but, as a rule, the plumbago is found near the surface. It is difficult to say how many men are engaged in digging plumbago, but taking half-a ton for each man per month in a favourable field as a high average, and making allowance for the wet seasons, holidays, &c., we may feel sure that no less than from 4,000 to 5,000 men were required to provide the quantity shipped last year. The carting to Colombo must have given employment to a good many others, perhaps more or less to 500 carters, carts and pair of bullocks. But it is the elaborate preparation now observed in the Colombo stores which has taken us by surprise. Plumbago is now picked and sized, we may say, as carefully as coffee. The various processes are seen to perfection at Mr. W. A. Fernando's store. He gives employment to from 120 to 150 men and women,* paying from 50 to 75 cents per

* Sinhalese women have only lately been induced to work as plumbago pickers; their manual dexterity give them an advantage over men, but Mr. Fernando had trouble in overcoming a strange prejudice they had to plumbago as posion or worse for them to touch with their fingers! Now they like the wrok and come to it readily.

diem to the former, and 25 to 30 cents to the women. His stores and picking-houses are all cadjan-roofed (that is, roofed with coconut leaves), for the very good, but to us novel and strange, reason that the tiles would inevitably fall off any roof under which plumbago was stored or prepared. The dust blown about makes everything so polished and slippery, even the roof rafters and reepers, that tiles constantly slip off, and therefore the only safety lies in cadjans! The process first is to wash the plumbago in large baskets, the smaller pieces and dust being afterwards spread on an asphalte barbacue to dry. By this means the quality is easily discovered by the practised eyes of the pickers, who separate (in much the same way as coffee) pieces affected by iron ore, pyrites, quartz, or other foreign material, a small piece of which passing into a consignment to the Battersea Crucible Works might ruin the whole lot. Some of the pickers are furnished with iron hammers to break up suspicious-looking pieces of the plumbago, and others again are employed in brushing the dust off good lumps, and polishing the same with coconut husks. There are punched sheet-iron sizers with holes of different dimensions (Nos. 1 to 4), and accordingly large lump, small pieces, chips and dust plumbago are now a days carefully separated. It takes about 100 expert men and women to prepare two or three tons in a day, consequently this branch of trade must give employment to several thousands of people for the greater part of the year. The cask-making and packing afford further occupation, each barrel holding about 5 cwts., so that some 35,000 casks all made of *Hora* staves (generally deemed a useless timber) were required for last year's shipments. The plumbago is also carried from the mines to Colombo in barrels, which, however, are sent back in shooks and so used repeatedly. Three men are supposed to make 8 or 10 barrels a day. Altogether therefore it will be seen that the Ceylon plumbago industry is a very important one to our Sinhalese neighbours.

Mr. W. A. Fernando, whose model store is well worthy of inspection, sells to the European mercantile houses as much as from 1,200 to 1,800 tons per annum. In olden days he used to ship on his own account, and he has received prices as high as £32 and £48 per ton for lump plumbago, which is now only worth £15. His Brownrigg Street Store should be visited during the busy season, by all who wish to get some idea of the importance of the PLUMBAGO INDUSTRY OF CEYLON.

Appended are extracts from the Annual Administration Reports of the District Revenue Officers of the Ceylon Government containing references to plumbago and other minerals :—

(*From the Report on the Sabaragamuwa District for* 1873.)

Plumbago, which sold at 200 rupees per ton, now realizes 90 rupees; the working expenses have considerably increased by the enhanced value of labour, and the difficulty of procuring suitable machinery in substitution thereof. One of the native Companies, I understand, indented for a force pump, but when it arrived, the hose was discovered to be one-fourth the size required by the machinery: so after pumping unsuccessfully for a couple of days, they gave up in despair and took to the hand-bucket system of raising water more adapted to their taste.

(*From the Report on the Sabaragamuwa District for* 1874.)

Very little mining operations have been carried on during the year on account of the scarcity of labour and low prices. Plumbago is at present unsaleable; iron cannot be manufactured for its marketable value; and even gems are not as plentiful as formerly. Of the latter, only three were of any great value, and realized from 3,500 rupees to 4,000 rupees each. It is most remarkable that gems command a higher price here than at Colombo or Galle.

On the discovery of a good "stone," correspondents advertise it in the local papers, and merchants from all parts of the country flock in and bid each other up to a ridiculous figure. There are instances where a sapphire, which sold here for 2,500 rupees, changed hands subsequently at Colombo

for 1,500 rupees; and in the case of the last find (a ruby, the size of a walnut) the owner refused 5,000 rupees here, to discover, on his arrival at Colombo, that it was flawed and worthless.

(*From the Report on the Hambantota District for* 1868.)

A new branch of industry—not in the interest of agriculture, indeed, but of mining—has, I am glad to be able to report, within the last few weeks, been introduced: one from which much good will result, both as opening out a fresh and remunerative field of labour, and inducing a flow of capital into the district. I allude to the finding of plumbago, of excellent quality, at Warapitiya in Giruwa Pattu near the Kirama Reservoir Traces of the mineral had previously been found in other parts of the Pattu: and I had long been of opinion that ample quantities would in time be brought to light The value of the discovery is not to be overrated, as the demand in England for the mineral, which is of the first importance in the arts, is immense and constant. The attention of merchants interested in the export of plumbago, is cordially invited to the discoveries recently made.* It may be worth while to note here also, that what is believed to be magnesian limestone occurs close to the main road to Badulla about sixteen miles north of Hambantota.

CEYLON KAOLIN FOR POTTERY.

(From the *Ceylon Observer*, July 28, 1879.)

We owe to Sir William Gregory (whose continued interest in Ceylon is being displayed in so many ways) a trial which has been given at "Minton's China Works" to a sample of our finest kaolin. better known by the native name kirimeti. We regret to say that the result has not been so favourable as was generally anticipated. In a Chinese history of the Ming dynasty, A.D. 1368-1643, "pottery-stone" is enumerated among the imports into China from Ceylon, and for a generation back we have been accustomed to regard our kaolin as equal to the manufacture of fine ware—Emerson Tennent declaring its colour to be so clear as to suit for the manufacture of procelain—the difficulty and cost of carriage alone rendering it unavailable for the European manufacturer. But the report of such competent authorities as "Minton's" to Messrs. Goode, London, runs as follows:—

"In your package to-day we send a breakfast cup and sauces made from the sample clays sent to you by the late Governor of Ceylon. We also enclose three sample 'bats' made from the same clay, the one marked No. 151 having been simply washed and then fired. From the sample now sent, you will see it is too full of dirt for our use. We have labelled the underside of the saucer."

The Colonial Secretary, Mr. Douglas, we believe, brought out the cup and saucer referred to, from Sir William Gregory, for deposit in the Colombo Museum. They are not regarded as a success by our late Governor, and, as there can be no doubt of the care exercised in selecting his sample of kaolin, there is not much encouragement to try again with further samples through "Minton's" or other home manufacturers, According to an analysis made in 1847, the kaolin of Ceylon consists of

Pure kaolin	70·0
Silica	26·0
Molybdena and iron oxide	4·0
	100 0

* A sample of the Plumbago has been submitted to the Colombo Chamber of Commerce, who pronounce the quality to be fairly good and likely to command about £12 or £14 a ton in Ceylon. The Chamber, I am happy to observe, exhibit a warm interest in the matter, which is one of great consequence to the district. It is probable the hill Ranmalakanda will be found rich in Plumbago and in Iron Ore.

THE CUP AND SAUCER made from Ceylon kaolin at Sir Wm. Gregory's instance will be on view henceforward at the Museum. They are pure white and well-finished, although bearing traces of impurity. The saucer has the following inscription in red script on the back :—Made with China clay, sent by the Governor of Ceylon, by Minton's, Stoke upon Trent, England ; March 11th 1879." Three accompanying specimens shew Ceylon china clay fully, half, and not fired.

"GEMS IN CEYLON."

A SAPPHIRE FOUND IN SABARAGAMUWA WORTH FROM R130,000 TO R140,000!

(From the "*Ceylon Observer*," June 6, 1881.)

In a letter received in Colombo to-day from Mr. C. M. Hassena Marikar, the well-known landed proprietor and gem-digger of Rakwana, he states that he has found a sapphire of the finest quality, weighing about seven rupees (over 52 dwts.) and which he therefore values at from R130,000 to R140,000! Allowing for the natural exaggeration of the fortunate owner, it is believed in Colombo that Mr. Hassena Marikar is safe to make £10,000 out of his find. It is surely time that European capitalists turned their attention to the Gem-digging industry and that the Government made the most of their property in this connection. We have been collecting for our pamphlet all the information available in every possible quarter about Ceylon Gems as well as Ceylon Gold, and we find much reason for believing that the Sabaragamuwa and adjacent districts—at least so far as sapphires, rubies, cat's-eyes and their inferior congeners are concerned—comprise one of the richest gem-yielding regions in the world. Sindbad's valley must be in the neighbourhood of "Ratnapura," "the City of Gems"! Ceylon indeed seems to be almost the only reliable source of supply now for a good many precious stones. It is significant of what is thought of the island in this respect, to find so good a judge and so large a dealer as Mr. Streeter advertising in all the best-known London journals, simply as follows :—

MR. EDWIN STREETER,
Dealer in Precious Stones,
of 18 New Bond Street
and
COLOMBO, CEYLON.

We believe there is a project on foot for the promotion of a "Ceylon Gem-digging Company, Limited," and that the prospectus is now in the hands of influential "City" men in London. Should such a Company be established, we may look for an entire revolution in the system of gemming at present in vogue in the island. Machinery will become the rule instead of the exception. Not only the pumping but much of the excavating work can surely be done by steam or water power applied to suitable machines. The Australian papers continue to bring us the most satisfactory accounts of the performances of Sir Thomas Elder's steam-coop, a machine which ought to be turned to account in more directions than one in this Colony.

PROBABLE INCREASED DEMAND FOR CEYLON GEMS.—We read in a home paper, that a novelty in the use of jewels has been inaugurated this winter by the Princess of Wales, who has been the first to wear an earring of sapphire set with diamonds in one ear and in the other a ruby likewise surrounded with brilliants. The fashion having been set, will no doubt be largely followed :—sapphires and rubies must be in request and there is no country we believe at this moment so well able to supply these gems as is Ceylon.

TEMPLE JEWELS.

A few of the jewels belonging to some of the Dewales (Temples) at Kandy given as specimens of value, are as follows :—

One small relic case set with precious stones, gold	£2,000
One gold betel stand set with rubies called Dalomarebattoo...	437
One gold book, written in Sinhalese letters containing 24 leaves and set with blue sapphires and rubies	562
One gold fan set with precious stones	48
One small relic case set with stones	1,000
One do Perahera karandu	300

THE ROCKS AND MINERALS OF CEYLON.

By A. C. Dixon, B. Sc., (Honors) London.

(From the *Ceylon Branch R. A. S. Journal*, 1880.)

The science of geology divides itself naturally into three departments :

(*a.*)—The study of rocks, or *Petrology.*

(*b.*)—The study of the minerals of which rocks are composed, or *Mineralogy.*

(*c.*)—The study of the remains of animal and vegetable life contained in the rocks, or *Palaeontology.*

To the one who makes this last division his object of research there is but a poor field before him in Ceylon, save in the north of the island ; but for the one interested in rocks and their component minerals, there is plenty of scope for research. Geological time is divisible into three great periods separated by great breaks in time, but this cannot really be the case, for, as nations have sprung up and passed away gradually, so also have formations. These have always been and will be continuous. Although in England we have great gaps separating one formation from another, yet we have beds of passage in several parts of the world, which bridge over these gaps and so form a connecting link.

The three great epochs of geological time are the *Palaeozoic* or old life period, the *Mesozoic* or middle life, and the *Cainozoic* or recent life.

Each of these has numerous divisions. The bulk of this island consists of ancient sedimentary beds ; whether deposited in sea or lake, we are unable to say, for the metamorphism which these beds have undergone due to internal heat, pressure, time and various other causes) has obliterated all traces of fossil remains. Over this *gneiss* around Colombo and in many other parts of the island, we have the well-known *laterite* or cabook, so largely used for building purposes. This formation has given rise to much discussion. It is essentially a derivative from the gneiss ; and, beyond doubt, in many cases *in situ*, as is evident in several cuttings which have been made, a notable one, which I visited some time ago, occurring in a cutting made while searching for plumbago between Polgahawela and Ambepussa. In many ravines in the hill districts of the island, especially in Dimbula and Dikoya, we have an iron conglomerate at present in course of formation, composed of the débris of surrounding rocks, firmly held together by ferruginous matter, which rock, when subjected to decay, would furnish a formation exactly akin to our laterite. I have dealt with this subject (Laterite) at greater length in a paper to the Royal Academy of Sciences, Sweden.

In the north of the island we have a formation of the Mesozoic, or secondary period, viz., the *Cretaceous*. These beds are no doubt contemporaneous with the Pondicherry beds, which have yielded numerous fossils, by which their age has been determined. I have no doubt that many fossils might be gathered in our Northern Province by those interested in Palæontology. Once, it is recorded, this Society possessed in its Museum a fossil phalange from this district, but it has been lost.

Of *recent* formations, we have on the sea coast between Negombo and Mount Lavinia, and for some distance beyond these places, a recent breccia formed of particles of disintegrated rock, more or less compact. At Talpitiya it occurs at a considerable distance from shore (300 yards), and at a depth of twenty-five feet. Numerous minute shells and fragments of shells occur

in this. At Pamunugama, on the way to Negombo, the sandstone varies much. In some cases it is black-banded, with particles of magnetic iron; in others the particles of iron are evenly distributed throughout the mass. The nature of the cement which binds these particles together is carbonate of lime.

Calcareous Tufa, still in the course of formation, is a deposit from the hot-water springs of Bintenna, the water of which is highly charged with carbonate of lime, which is deposited as the water cools. It is known as Pennagal by the Sinhalese, and is burnt and used by them along with their betel.

The foregoing formations are indicated on the accompanying rough geological sketch map.

I will now consider more particularly the *gneiss*, which is our most extensive formation. It varies much in texture, colour, composition, hardness, &c.

Its composition is the same as granite, only the degree of metamorphism has not been so great as to entitle it fully to that name.

It is composed of quartz—felspar (both orthoclase and oligoclase)—muscovite and biotite (micas), hornblende, chlorite, and numerous accidental minerals in varying proportions.

In some localities we find a rock composed of only one of these, as in the case of hornblende rock; at other times only felspar, but generally the foregoing components are mingled together in varying proportions, giving a large number of different kinds of rock.

Orthoclase forms the main mass. The two felspars are easily distinguished on a weathered surface. The orthoclase is glassy and somewhat pearly in lustre, and has a translucent aspect, while the oligoclase is dull and opaque.

In the gneiss we meet with various *beds* as limestones, dolomite, magnetite, quartz, hornblende, tremolite, mica, epidote. Some of these occur, also, as *veins* in the gneiss.

In the veins we have the minerals, actinolite, tremolite, jade, talc, muscovite, biotite, epidote, schoral, and many others of minor importance.

Actinolite is found in the Kotagala district. Good specimens of crystalline talc are obtainable from Mahara quarry and neighbourhood.

The gneiss in some cases almost passes into syenite. Where the felspar is flesh-coloured, this rock much resembles Peterhead granite. Porphyritic gneiss occurs on the hill ranges not far from Heneratgoda.

At Balangoda we meet with a crude jasper, and not far from the same locality a large mass of graphic granite in which the quartz is distributed in bands, and when viewed endwise much resembles an inscription.

When subject to action of water the felspar of the gneiss soon decomposes, and so a large number of decomposed forms are very abundant. As the island is gradually uprising it is evident that the less elevated portions have been under the influence of water for a longer period, and, consequently, the cuttings through such are less difficult than similar ones in the more elevated portions. Another peculiarity of the gneiss is the occurrence of garnets in large quantity.

Dolomite beds. As far as I have been able to trace during the time at my disposal, I find that these beds run through the gneiss in a somewhat parallel direction, striking generally N.W. by N. to N., and having various angles of dip from 10° to 40°.

I have indicated their position on the map. The first is one which outcrops a few miles this side of Balangoda, and runs N.N.W., occurring again at Hanuwala.

The second runs through Dolosbage and Maskeliya; probably the bed occurring at Bilhul-oya is continuous with this.

The third outcrops under the Great Western on the Great Western estate, and is continuous to the N.N.W. with the Wattegoda and Medakumbura dolomites, and probably also with the beds at Gampola and Kurunegala. A subsidiary bed—or it may be an outlier of this—occurs near the Pussellawa rest-house.

The fourth bed outcrops largely at Wilson's Bungalow, Glen Devon, Dumbara and Matale.

The fifth occurs in the Badulla district. As in the gneiss we have a great many varieties, so also in the dolomites. They all contain carbonate of magnesia, which varies from 1 to over 40 per cent.

These limestones are very valuable for estate purposes as well as for building stone and building lime.

In colour they vary much, dependent on the numerous accidental minerals that occur along with them. Thus the specimens from Wilson's Bungalow are very dark: they contain pyrites, phlogopite, chlorite, epidote, &c.

A dolomite occurring at Wariapola on the Matale railway contains a large amount of blue spinel. Some of the crystals of these dolomites have large facets, others small and of a granular texture. Many contain white translucent siliceous grains not easily distinguished.

A beautiful example of limestone of a somewhat peculiar tinge, due to the metal chromium, occurs beyond Balangoda, and often contains fine specimens of crystaline biotite—a magnesian mica. This limestone shews a very peculiar and characteristic weathered surface.

Plumbago is found in several localities, as at Kurunegala, Kegalla and Nambapana. In the Balangoda district we have the metal molybdenum, so useful in chemical researches; and black oxide of manganese from Ratnapura and neighbourhood.

Various forms of iron occur in the gneiss, thus iron pyrites. Magnetite, a very highly magnetic iron ore, is found in the Pussellawa district with a peculiar cleavage and fracture. Botryoidal limonite, an oxide of iron found under the cinnamon sand near Negombo. Haematite occurs in other parts of the island.

Traces of gold and platinum I have met with in the Ramboda and Kurunegala districts. Extensive beds of quartz occur in the Pussellawa district, which is not much unlike the reef-bearing quartz of the Wynaad.

In some localities the felspar of the gneiss is much decomposed and forms large masses of kaolin (*Kirimeti* of the Sinhalese), occurring largely in the Nuwara Eliya and Maturata districts. This is capable of being made into a very fair procelain.

Large masses of *alluvium* occur on the Nuwara Eliya plain, and shew us the remains of the surrounding hills, deposited no doubt in a former lake.

In the alluvium of many of our river basins, notably at Ratnapura, we have numerous minerals—the *gems* for which this town is so noted. I will briefly notice some which I have gathered there.

First, I will deal with the corundum or sapphire family, which crystallizes in the hexagonal system. If a stone of this family lacks transparency and is dull, we call it corundum: it is useful as a powder (emery) for cutting other stones. If of a rich blue colour it is called sapphire; of white, white sapphire; red, ruby; purple, the oriental amethyst; of yellow, the oriental topaz; of green, the oriental emerald.

Some of the sapphires are partly blue and partly white. The Sinhalese can, by heating these in a certain manner, distribute the colour evenly, or by greater heat can discharge the colour and so pass them off as white sapphires. The specific gravity of such, however, is diminished. Many other stones, as the zircon, are treated in a similar manner. A good test for a sapphire is, that in a dark room or closet, with the light of a match or candle, it should appear equally rich in color as in ordinary light. Sapphires are lamellar in structure, and so on being cut of a convex form, we have the appearance of a six-rayed star.

Spinel. Another mineral abundant in Ceylon crystallizes in the cubic system generally in octohedrons or rhombic dodecahedrons. In colour this mineral varies much; red, however, is very common, and it is sometimes sold as ruby. The specific gravity of spinel is about 3·5, while ruby is 4 and garnet 3·8.

Green spinel is occasionally met with at Ratnapura and in the Kandy district.

Garnet, of various kinds, is found in Ceylon both in the metamorphic rock as well as in the alluvium. This is usually of a red colour, and crystallizes in the cubic system.

Cinnamon stone (essonite) is a kind of garnet found largely at Matara.

Zircon crystallizes in the tetragonal system, and is found of many colours. Several varieties are disregarded by the Sinhalese; others are used, notably the white zircon, otherwise known as the Matara diamond. Quartz is often cut and sold as Matara diamond.

Chrysoberyl belongs to the rhombic system of crystals, and when cut *en cabochon* furnishes the true cat's-eye.

Tourmaline (S. Toramalli) crystallizes in the hexagonal system, generally in the prisms with dissimilar ends. In colour it varies much; thus, we have black, green, brown, yellow, &c.

The peridot of Ceylon is yellow tourmaline. The natural crystals shew a fine striation on their long sides.

Moonstone or adularia is a felspar with a pearly appearance. Quartz and selenite are often sold under the same name.

Rock crystal crystallizing in the same system as the sapphire, and is very abundant at Ratnapura, Balangoda and many other localities.

SPECIMENS EXHIBITED, ILLUSTRATING THE PAPER READ.

1. Gneiss—with large flesh-coloured crystal of felspar. Balangoda.
2. Gneiss—with molybdenium from Petiagalla.
3. Gneiss—with iron garnets. Kotagalla.
4. Gneiss—with ordinary garnet. Madola. Sabaragamuwa.
5. Gneiss—with quartz crystal, epidote, &c. Mahara.
6. Epidote and black mica. Ythanside, Dimbula.
7. Gneiss form under gem-pits. Ratnapura.
8. Gneiss with epidote. Ramboda.
9. Hornblende pebble. Madola.
10. Graphic granite. Balangoda.
11. Crude jasper. Balangoda.
12. Gneiss—decomposed. Abbotsford, Dimbula.
13. Gneiss—decomposed, with epidote, chlorite, &c. Balangoda.
14. Quartz—with plumbago. Diatura, Kurunegala.
15. Hornblende (crystalline). Matale Railway.
16. Mica—pebble. Dimbula.
17. Mica—from cabook. Welikada, Colombo.
18. Mica—much decomposed. Ratnapura.
19. Iron conglomerate. From ravines, Dimbula.
20. Iron ore. Dimbula.
21. Decomposed gneiss from a slip on Matale Railway, shewing the nature of "slickensides."
22. Magnetite. Harmony estate, Pussellawa.
23. Cabook. Colombo.
24. Limonite (botryoidal). Negombo.
25. Dolomite, with large crystal of mica. Nonpareil, Bilhuloya.
26. Dolomite, with epidote, &c. Aluwihara, Matale.
27. Dolomite, with pyrites and other crystals. Kurunegala.
28. Dolomite, with garnets, epidote, mica. Wilson's Bungalow.
29. Dolomite, with blue spinel iron, mica. Wariapola, Matale.
30. Dolomite, very compact. Wilson's Bungalow.
31. Dolomite, with black weathered surface. Wattegoda, Dimbula.
32. Dolomite, large yellow free crystals. Kurunegala.
33. Dolomite, with curious weathered surface and containing mica, iron, plumbago, quartz, &c. Balangoda.
34. Dolomite, very impure, abounding in quartz and shewing a peculiar weathering. Great Western, Dimbula.
35. Kaolin, red, impure. Maturata.
36. Kaolin, white, very pure. Nuwara Eliya.

37. Manganese (black oxide). Ratnapura.
38. Iron, pyrites. Mahara.
39. Felspar, decomposing. Nuwara Eliya.
40. Labradorite. Mahara Quarry.
41. Rock crystal, smoky. Nuwara Eliya.
42. Rock crystal, white pebble. Ratnapura.
43. Sandstone with numerous shells. Talpitiya.
44. Sandstone with magnetic iron in bands. Pamunugama.
45. Sandstone with iron evenly distributed. Pamunugama.
46. Sandstone, very dark. Pamunugama.
47. Limestone from Jaffna (Cretaceous).
48. Quartz (vein). Balangoda.
49. Gneiss with silvery mica, green, blue, and red sapphire. Badulla.
50. Talc, crystalline. Mahara Quarry.
51. Gneiss with garnet. Top of Adam's Peak.
52. Calcareous Tufa. Bintenna.
53. Clay from gem pits.
54. Calcite. Matale.
55. Felspar, crystal. Ythanside.
56. Sapphire crystals. Ratnapura.
57. Sapphire (star).
58. Sapphire, white.
59. Sapphire, yellow.
60. Sapphire, parti-coloured.
61. Corundum.
62. Ruby.
63. Amethyst, crystal.
64. Amethyst, cut.
65. Spinel. Ratnapura.
66. Spinel. Wattegama.
67. Zircon.
68. Zircon (cut). Matara diamond.
69. Chrysoberyl.
70. Chrysoberyl (cat's-eye).
71. Alexandrite.
72. Garnets.
73. Cinnamon stone.
74. Cinnamon stone (cut).
75. Tourmaline, crystal.
76. Peridot of Ceylon.
77. Moonstone.
78. Moonstone, cut.
79. Quartz crystals.
80. Actinolite.
81. Iron pyrites. Gem.pits.
82. Steatite. Nuwara Eliya.
83. Zircon (white). Ythanside, Dimbula.
84. Gems. Pelawatta.
85. Gem sand.
86. Black crystal. Deduru-oya, Kuruncgala.

INDIAN GOLD MINING COMPANIES.

Enterprise in connection with the gold fields in the Wynaad and Mysore districts of Southern India has now acquired so considerable an extension, that the subjoined particulars, compiled and supplied by a correspondent of the *Financier*, will be found interesting. A complete view is here given of the extent to which British capital has become engaged in this direction. The figures are all carefully taken from authentic sources, and the most recent statements emanating from the several companies, and, when in doubt, they have been verified by direct inquiries at the offices :—

INDIAN GOLD MINING COMPANIES IN THE WYNAAD DISTRICT OF MADRAS. ALL IN SHARES OF £1 EACH.

Date of Issue.	NAME	Capital.	Price in Cash and Shares.	Acreage of		
				Whole Property	Mining Rights.	Surface Rights.
1879						
Dec. 5	South Indian (a)	100,000	50,000 & 7,500	1200	1200	1200
1880						
Jan. 27	South-East Wynad Estates (b)	100,000	60,000	2536	736	2536
Feb. 2	Indian Glenrock (c)	100,000 & 40,000	50,000 & 35,000	3150	3150	3150
April 10	Indian Grange (d)	100,000	47,000	300	300	300
April 13	Balcarris (e)	180,000	100,000	1198	1198	1198
June 25	Devala Moyar (f)	200,000	132,000	2055	1029	2055
Aug. 14	Devala Provident	75,000	30,000	120	120	120
Aug. 21	Indian Mammoth	150,000	70,000	1500	1500	1500
Sept. 18	Wynaad Perseverance (g)	80,000	50,000	600	15	600
Oct. 15	Indian Phœnix	150,000	85,000	800	800	800
Oct. 15	Wala Wynaad Indian	75,000	35,000	500	339	339
Nov. 4	Devalah Central (h)	120,000	70,000	986	25	986
Nov. 11	Rhodes Reef (i)	190,000	130,000	50	50	50
Nov. 18	South-East Wynaad	100,000	65,000	677	677	677
1881						
Jan. 3	Needlerock Estate (k)	125,000	85,000	250	250	250
Jan. 3	Charambadi (Wynaad) District	100,000 Issued 50,000	32,000	200	200	200
Feb. 4	Indian Trevelyan (l)	150,000	96,000 & 4,000	930	930	930
Feb. 10	Tambracherry Estate and Wynaad	160,000	120,000	6184	6000	6000
Mar. 19	Carta Para	50,000	½ net profit	300	300	300
Mar. 21	Dingly Dell Estates (m)	100,000 power to inc.	70,000	600	415	415
Mar. 21	Simons' Reef (m)	120,000	—	—	—	—

(a) Has just sold about 600 acres (Attikunno Estate) for 46,000*l.* (and 4,000*l.* for surface rights) to the Indian Trevelyan. Machinery is now on spot and in course of erection.

(b) Including Needlerock Estate. Has option of extending mining rights any time during the next four years.

(c) Machinery on spot and in course of erection.

(d) Withdrawn.

(e) Withdrawn.

(f) Since sold 50 acres to the Rhodes Reef Company for 130,000*l.*

(g) Same Board of Directors as South-East Wynaad Company. Can have increased acreage of mining rights any time before 1886.

(h) Indian Gold Mines Company (of Glasgow) to crush this company's ore. Can increase acreage of mining rights at option before 1886.

(i) Same Board of Directors as Devala-Moyar.

(k) Withdrawn Feb. 22.

(l) Bought about 600 acres of the South Indian Company.

(m) Not yet issued to the public.

INDIAN GOLD MINING COMPANIES IN THE KOLAR DISTRICT (MYSORE TERRITORY), MADRAS. ALL IN SHARES OF £1 EACH.

Date of Issue.	NAME.	Capital.	Price in Cash and Shares	Acreage.	Full Mining Rights for
1880					
July 6.	Mysore	135,000	55,000	750	30 years
Oct. 15	Colar	150,000 Issued 75,000	40,000	320	do.
Oct. 24	Ooregum	125,000 Power to inc.	75,000	256	do.
Nov. 8	Nundydroog	100.000	50,000	494	do.
Nov. 19	Mysore Reefs	120,000	75,000	320	do.
Dec. 28	Gt. South. Mysore	75,000	45,000	150	do.
1881.					
Jan. 27	Madras	135,000	85,000	320	do.
Mar. 24	North Ooregum	120,000	75,000	320	do.

NOTE.—Besides the above companies, the following were registered in 1880:—The Indian Goldfield Cooperative Association, capital 1,200,000*l.*, in 1,000 shares of 120*l.* each, and 90,000 shares of 12*l.*; Nilghery and South Indian Gold Mining Syndicate, capital, 7,500*l.*; but I have not been able to obtain any further particulars of them, A Company called the Gold Company of Southern India is also very early in the field. Its prospectus stated that it started "unfettered with any contracts," but proposed to use the 100,000*l.* it asked for to find and purchase a suitable estate. In the second prospectus the company announced its intention of buying the Lakadio and Matudella Estates for 45,000*l.* Shortly after this the company was voluntarily wound up, and the South-East Wynaad Gold Mining Company now owns these two properties, for which it paid 65,000*l.* This makes a total of thirty-two South Indian Gold Mining Companies registered in London since Dec. 1, 1879—say sixteen months.

Taking out of the calculation all Companies which are known to have been withdrawn, or which have not yet been publicly offered, the figures come out thus:—Sixteen Wynaad Mines: capital 1,890,000*l.*, of which the vendors take 1,121,500*l.* (and half profits on Carta Para), leaving a total working capital of 768,500*l.* The total acreage is 22,388 acres, so that the price paid to the vendors averages 50*l.* 1*s.* per acre. Seven Mysore mines: capital 750,000*l.* of which the vendors take 415,000*l.*, leaving a total working capital of 335,000*l.* The total acreage is 2,930 acres, so that the price paid to the vendors averages 141*l.* 12*s.* 9*d.*

But the average price paid per acre is of course no guide to the value of a mine, although many seem inclined to lay much stress upon it; and the only reason for setting out the above calculation is to show why separate tables have been made for the two districts in which the mines are located. People are too apt to look upon these districts as merely different parts of the same gold field, whereas they are 240 miles apart, and must be developed under different conditions. The relative price paid per acre in each gold field is cited to bring this difference home to all interested.—*Overland Mail.*

MR. BROUGH SMYTH ON THE WYNAAD GOLD FIELDS.

(From the *Madras Mail*, March 4, 1880.)

The last *Gazette of India* contains Mr. Brough Smyth's long-looked for report on his explorations in the Wynaad. The report, with its appendices,

occupies 90 pages of the *Gazette*, and contains a mass of information on gold-mining which those interested in the subject will do well to make themselves acquainted with. All that we can do here is to give a brief sketch of the subjects dealt with in the report, a summary of which has already been issued by the Government of India, and was published recently in the newspapers.

The area examined by Mr. Smyth is as follows: (1) the country drained by the western tributaries of the Pandi river, east of the dividing range, from the sources of the Kailakahpoya to Manpanmadi North Peak; (2) that drained by the southern tributaries of an affluent of the Noogoo river from Hadiapetta to Marpanmadi North Peak; (3) the country between Cherambadi and Vellirymulla; (4) the basin of the Kailakahpoya from Devala to a point below Eddakurra; (4) Navfanad, Avalandi and Sispara. Nowhere in the Wynaad does the character of the vegetation help the gold-seeker, whereas in Australia the several geological formations are marked by forms of vegetations of distinct types. The Wynaad gold-miner must, it appears, trust chiefly to an examination of the rocks, of which, however, the outcrops are numerous. Between Moopenad and Cherambadi, a distance of 11½ miles, Mr. Smyth observed twenty-three outcrops of quartz, many of them indicating reefs of great thickness; from Cherambadi to near Nadukani there were seen eighteen separate veins, and to the east and south-east of Devala, the reefs are described as being only a few chains apart. Another important aid to the gold seeker is mentioned by Mr. Smyth: "In South-East Wynaad, on washing a few dishes of the surface soil anywhere, a few specks of very fine gold will be found; in the vicinity of the reefs rather heavy gold is often got by sluicing." Mr. Smyth is of opinion, however, that there will be no alluvial mining in the Wynaad. "There are here no gullies having in their beds shallow deposits with a well-defined auriferous stratum, no 'deep leads' covered and protected by layers of volcanic rock; there are only, as a rule, in the district now under consideration, surface and quartz mining."

Mr. Smyth again refers to the probable antiquity of the gold mines in the Wynaad, and quotes Dr. Burnell's recently deciphered inscriptions on the temple at Tanjore in proof of his surmise. According to the writing on the Tanjore wall, in the eleventh century "gold was the most common precious metal in India." "Stupendous quantities of it are mentioned here," says Dr. Burnell, referring to the inscription; "silver on the other hand is little mentioned, and it thus appears that the present state of things, which is exactly the reverse, was only brought about by the Portuguese in the 16th century. I submit that the great abundance of gold spoken of in the inscription can have arisen only from mines, and that in the terrible convulsions caused by the irruption of Moslem invaders from the north and Europeans from the west, the position of these gold-fields was lost sight of." Mr. Smyth tells us that in many parts of the Wynaad district the remains of the walls built by the ancient miners, when ground-sluicing, and heaps of rubble extending over many acres, are still to be seen. Indeed the evidences of the patient labours of the native miners are so numerous, and are found in so many localities, "that one pauses to consider the length of time which must have elapsed since gold-washing first became an established industry in this part of India." We are glad to see that Mr. Smyth has given some attention to the historical view of gold-mining, for it must be admitted that next to a professional examination of the gold-bearing rocks, it is one of the best evidences we are likely to get of the present existence of gold in the Wynaad. Admitting the fact of the existence of old workings, there is no reason to conclude that the rocks have been exhausted of their precious treasures. We may be sure that all the streams and slopes where the richer earths had accumulated, and all the outcrops of quartz where gold was visible to the eye, were eagerly attacked by the natives, and that at all times the miners endeavoured to discover the most productive patches. In fact, Mr. Smyth believes the natives pretty well exhausted the mines as far as they were able to work. But after all their system of working was little more than surface mining. The

quartz reefs many feet below the surface were not touched, and never will be till the modern system of mining is introduced into the Wynaad. It is in this respect that the Wynaad gold-fields promise such hopeful results. Referring to the yields of gold obtained on testing quartz at various localities, Mr. Smyth remarks that in the greater number of cases the stone was broken from outcropping rocks, and that it is matter for surprise that such a large number of them should have yielded so well. The details given by Mr. Smyth of his examination of various estates and localities will be most useful to intending selectors of land, but it is unnecessary that we should allude to them here. His report is, we think, conclusive as to the existence of gold over a considerable area of country, while he has no doubt that several localities will hereafter be the scene of successful mining enterprises.

Mr. Smyth thinks it very possible, however, that some of the first attempts at mining will fail. "Speculative undertakigs having for their object the making of money by buying and selling shares are commenced invariably by appointing Secretaries and Managers at high salaries, and the printing of a prospectus. This is followed by the erection of costly and not seldom wholly unsuitable machinery; no attempts are made to open the mine; and then after futile endeavours to obtain gold and a waste of capital, it is pronounced and believed that gold-mining on a large scale will never prove remunerative. It is probable that this story will be repeated again and again, here as in other gold-mining countries, until some one of the mines is opened by experienced persons who desire to secure profits not by dealing in shares but by mining." We are quite sure that those who are inclined to invest in mining properties would do well to take this advice to heart, more especially as the tendency seems at present to be to form large gold-mining Companies in London and elsewhere, rather than on the spot, where the difficulties connected with the introduction of enterprises of this character are more likely to be understood. Mining for gold cannot be conducted successfully in a hap-hazard way, says Mr. Smyth, and it would be as reasonable to place a landsman in charge of a ship, as to give the control of a gold-mine and gold-mining machinery to a man who is not qualified for this work. These are truisms, no doubt, but they seem to have been suggested to Mr. Smyth by the failures of recent attempts at gold-mining in the Wynaad.

After giving a very detailed account of his survey of the country reported on, Mr. Smyth tells us what kind of machinery should be obtained for treating auriferous quartz. This part of his report should be of great practical value at the present time. Still more important are his remarks on the treatment of pyrites. We may go so far as to say that is the most important lesson to be learnt in gold-mining, more especially as pyritous stone seems plentiful in the Wynaad. "It is now known," writes Mr. Smyth, "that gold in the Wynaad is usually most plentiful in the parts of the reefs which contain pyrites, and therefore the methods of extracting gold commonly adopted in Australia are most likely to give good results." No company can afford to ignore Mr. Smyth's advice on the treatment of pyrites; ignorance or carelessness in this particular has been the ruin of a vast number of companies in Australia. Put in another form, Mr. Smyth's warning amounts to this: "You must have proper machinery, if you wish to work quartz mines successfully, and you must have men who understand how to work the machinery properly." That the machinery is not of a very expensive character may be inferred from Mr. Smyth's estimate of a complete plant—consisting of ten stamp heads with engine, stone-breaking machine, buddle, saw and frame, necessary buildings, reverberatory furnace, and all other works—for £5,000. Mr. Smyth declines to discuss the question whether it would be advisable to introduce Chinese miners to work in the gold-mines. There will be no insuperable difficulty, we imagine, about obtaining local, or rather Indian labour. Upwards of fifty coal-mines are now being profitably worked in Bengal, and surely where men can be procured to labour in coal-mine, they may be found willing to work in quartz-reefs. Mr. Smyth dwells on the fact that the Wynaad has an abundant water and a good

timber supply, and that there are considerable facilities, therefore, on the spot, for conducting mining operations.

In concluding his report, Mr. Smyth remarks:—"The facts will speak more strongly than words to those acquainted with gold mines. Gold has been found on the south near Eddacurra and on the north near Nellacottah, on the west near Vyteri, and on the east as far as Bolingbroke, that is to say, over an area of more than 500 square miles. The reefs are very numerous and they are more than of the average thickness of those found in other countries; they are of great longitudinal extent, some being traceable by their outcrops for several miles; they are strong and persistent and highly auriferous at an elevation of less than 500 feet above the sea, and they can be traced thence upwards to a height of nearly 8,000 feet; near them gold can be washed out of almost every dish of earth that is dug; the proportion of gold in some of the soils and reefs in the neighbourhood of Devala is large; and, the country presenting the greatest facilities for prosecuting mining operations at the smallest cost, it must be apparent to all who have given attention to this question, that sooner or later gold-miming will be established as an important industry in Southern India."

(From the *Madras Mail*, March 11, 1880.)

The prospects of gold mining in this part of India are rapidly improving. That the precious metal exists over a wide area in the Wynaad and Mysore is now established, and it only remains to ascertain whether the quantity is sufficiently large to be worth mining for. The auriferous regions have been now very carefully surveyed by several specialists from England and Australia, and the conviction is taking possession of our mind, that the Madras Presidency is "in for a good thing" at last. There are four Companies have been started at home for the purpose of mining for gold in these parts, and the £1 shares of one of them had advanced to cent per cent premium, or to £2, according to our latest advices from London. We fear that some good money will, as usual, be dropped by speculators before large dividends can be paid by any of the Companies that are already started, or that are being set on foot. Mr. Eastwick has an idea that the "Havilah where there is gold," to which reference is made in Genesis, is synonymous with Devalah in the Wynaad, where gold certainly exists. There are already fourteen mines at or near the Devalah, and there can be no reasonable doubt that large quantities of gold were in olden time obtained from the locality. In fact before the discovery of the gold fields in Australia and California, India would seem to have been the country whence the World drew the bulk of its gold supply. So recent as the eleventh country, if the inscriptions on the Tanjore temple which have been deciphered by Dr. Burnell may be relied upon, "gold was the most common precious metal in India, and stupendous quantities of it are mentioned here;" whereas silver was hardly known in India until the 16th century, when the Portuguese brought it to India with them. Parts of the Wynaad and Mysore are honey-combed with ancient mines; and the contention is that the miners with their rude appliances only tapped the shell of the Indian El Dorado. Those ancient miners were "in the habit of making their shaft in a triangular form, they lighted fires in two of them to calcine and break up the rocks, and by the third, which also gave the draught of air necessary for the fires, they ascended until the shafts in which the fires were had cooled." Nothing could well be more primitive. But now quartz-crushing machines of the newest types, and skilled engineers and miners, are hurrying to India to dive far deeper into the bowels of the earth than their predecessors in ancient times ever dreamt of men penetrating; and should they come up smiling with quartz much impregnated with gold in their hands, we may have to record a great change for the better in the condition of this Presidency and Mysore in general, and of the coffee lands of Wynaad in particular.

THE COLAR GOLD FIELDS.

(From the *Madras Mail*, April 15, 1880.)

The appearence in another column of Messrs. Arbuthnot and Co.'s preliminary advertisement of the Madras Gold Mining Company will set the local public enquiring for information about the Kolar reefs to which reference is made; and we therefore give the following dispassionate particulars. The investigations made in the Western Ghats by Mr. Brough Smyth, under the direction of Government, and the official papers thereon, which have been published from time to time, have enabled the public to form a clear idea of the mining prospects of the Wynaad; but concerning the Colar gold fields, very little has been promulgated.

The auriferous zone in the Colar district runs from north to south, at an elevation of about three thousand feet above the level of the sea. Like those in the Wynaad, the reefs in this neighbourhood have for centuries been known to the natives of the adjacent country. Remains of extensive gold workings are still traceable in many places, some of which—as late borings have proved—were carried to a depth of seventy feet. The operations of the inhabitants do not appear to have exceeded that limit, however, and as they were ignorant of the use of timber in shaft sinking, accidents occurred so frequently that many years ago the Mysore Government put a stop to the excavations. As far as can be ascertained, the primitive method adopted by the native miners of old. was as follows :—They dug a V-shaped pit with sloping sides, on the dip of any reef that was found to be auriferous at outcrop. The reef was then followed down, and all the small leaders,—usually much richer in gold than the main lode,—were taken out, together with that portion of the reef itself, which appeared to contain the most valuable stone. The water, generally found about twenty feet from the surface, was baled out in chatties. A string of coolies, placed in line along one sloping side of the pit, passed the vessels from one to the other out of the mine, while another gang similarly disposed passed the pots back as they were emptied. In an ordinary shaft drained by a steam pump the discharge of water from a depth of eighty feet is forty-five gallons a minute. If, therefore, the natives of the surrounding villages were able to carry on work for generations at a profit in the teeth of the difficulties, and in the tedious manner we have described, it is fair to assume that the stone they raised must have been rich. This conclusion is almost placed beyond a doubt when their system of extracting the metal is considered. Though, in its way ingenious, one more innocent of science, or wasteful, could scarcely be described. From the quantity still lying on the ground, it would appear that when raised the stone was picked, or, in mining phraseology 'sampled,' that which was considered the richest being crushed upon the surface of the massive boulders which abound in the immediate vicinity. A round stone was used as a crusher, and, when ground sufficiently fine, the pulverized quartz was washed by women and girls in wooden dishes. The particles of gold were then amalgamated with quicksilver, and the amalgam, after all superflous mercury had been pressed out through the corners of the women's cloths, was placed in a piece of wet rag, and tightly twisted. This was next held in the flame of a lamp which generated sufficient heat to blow off the quicksilver, and the pellet of gold remained in the burnt cloth. To this day every woman in the neighbourhood of Ooregum possesses a washing dish, and after heavy rain never misses the opportunity of washing the sand deposited near the large reefs by the rush of water. On such occasions large gangs of villagers are to be seen at work, to all of whom the process of washing, and the art of amalgamating the gold and saving it, are thoroughly familiar.

According to the late Mr. Lindon, a mining engineer of great experience who visited the spot some few years ago, the Colar field contains several main reefs with a number of smaller veins, so to speak, all running north and south, and dipping west. In giving this opinion, Mr. Lindon only repeated what had already been pointed out by Mr. King of the Geological Survey, who had been over the field some time previously, and whose

valuable reports upon the gold-yielding reefs of Southern India, seem of late to have been lost sight of. Whatever subsequent enquiry may have done, we ought not to forget that Mr. King's was undoubtedly the first voice that really called public attention to what may prove to be the financial salvation of the Indian Empire. The Colar reefs vary in thickness, measuring in some places as much as twelve feet, and in others as little as two feet. All are well-defined, and as a rule, the stone becomes richer, the deeper the miner sinks. The surface earth of the whole field contains gold in minute particles, and in the opinion of some miners alluvial deposits may yet be discovered. All the reefs that have been tested have been found to contain gold in good quantity when sunk into. Stone taken at 35 feet from the surface, out of the reef now being worked by the Ooregum Company, gave over four ounces of gold to the ton, and a series of assays made of stone excavated at a depth of ten to fifteen feet yielded an average of over an ounce. A shaft is now in process of being sunk, in order to cut the reef at a depth of one hundred feet. Machinery for crushing is in course of erection, and the Manager, an Australian mining engineer, of twenty-five years' experience, firmly believes in the paying properties of the stone.

The Colar gold field was acquired some time back by a few gentlemen who went to the expense of thoroughly prospecting the reefs, and then marked the ground out in blocks of about 250 acres each. One of these has been handed over to the Ooregum Company ; three other blocks have been sold in England ; and negotiations for further sales are in progress. The rate at which sales are being effected is from £30,000 to £40,000 the 640 acres.

The following are a few of the tests of stone taken from reefs in the Colar field :—17½ tons of stone excavated at seventy feet from surface yielded 40½ ounces of gold. Quartz taken from the same reef, and assayed in London and Melbourne yielded :—

No. I.—A sample from the top of the reef sixty-six feet from the surface and not specially picked :—2oz, 12 dwts.—6 grs. per ton.

No. II.—Stone taken at random after sinking a few feet into the reef :—4oz., 1 dwt.—16 grs. per ton.

No. III,—Picked samples with gold visible on the surface of the quartz :—45oz, 4 dwts.—20 grs. per ton.

Another test of picked stone from the same reef gave 28oz., 14 dwts,—22 grs. to the ton.

The metal itself is of fine quality, as the following analysis by the late Dr. Oldham, Superintendent Geological Survey, shows :—

"Pellet amalgamated gold Colar quartz : weight pellet, 12·275 grains. Obtained by assay 11·27 grains. Silver ·19—percentage of gold 91·66 of silver 7·40. The weight of gold and silver obtained is of course a little less than the weight of the pellet. This is owing to slight impurities unavoidably mixed with the metal : there was a mere trace of mercury."

As far as climate is concerned, the Colar field can challenge close criticism. Situated just above the ghats, on the plateau of Mysore, it is similar to that of Bangalore, where Europeans can work all the year round, and natives have no dread of malarious fevers. In the matter of facility of transport and communications, the field could scarcely be better off : it lies within six miles of the Colar Road Station on the Bangalore Branch Railway, from whence the journey to Madras occupies only ten hours, and that to Bangalore two. The features of the country offer no obstacles to wheeled traffic, as the field lies beyond the hilly tract which the traveller passes through after leaving Jollarpet, and ascending the Ghat. Water is easily found as previously mentioned, fuel is abundant, and supplies of all kinds are easily obtainable. Touching labour—a most important item—the miners of Colar have no anxiety, for it is plentiful and cheap. The natives of the District take kindly to the employment, and when well supervised, make capital underground workmen. In the transport of machinery and building materials there is every facility at hand.

INDIAN GOLD FIELDS.

(*From Mr. Brough Smyth's Official Report.*)

Features of the country in the southern parts of the Nambulukod and Munanad Amshoms.—The chief physical feature in that portion of South-East Wynaad, which has been examined, is the dividing range extending from Hadiahbetta on the south-west to Marpanmadi North Peak on the north-east. This range separates the waters of the Pandi river from those flowing to an affluent of the Noogoo river, and for a portion of its length forms the boundary between the Nambulukod and Munanad Amshoms.

The ridge from the edge of the Carcoor ghât to a rocky eminence near Needle Rock is covered with thick jungle. The lower slopes have been cleared and are now planted with coffee.

The culminating points of this part of the range are Hadiahbetta about 4,000 feet, Needle Rock 4,600 feet, and Marpanmadi North Peak 4,650 feet.* The lowest "saddle" in that part of the range near Devála is approximately 300 feet below the general level of the summit.

On the east and west side of the range there are lower ranges—the boundaries of distinct small drainage areas—but they are not continuous, well-defined even ridges; they consist of rounded hills having smooth contours and connected with each other by low saddles, thus reminding one rather of those areas in which granitoid rocks prevail than of those in which, in other auriferous regions, the even symmetrical, almost rectangular, ranges of the lower Silurian rocks offer so many facilities for sketching the country with accuracy and comprehending rapidly its systems of drainage.

At the foot of the hills and at levels varying but slightly, there are numerous swamps and flats (usually intersected by small water-courses) which are in part cultivated by natives.

The summits of the hills forming the subordinate ranges are from 100 feet to 400 feet and more above the level of these swampy flats. The swamps are natural water-reservoirs, the water being stored in the strata overlying the bed-rock. They are generally well grassed, but some are mere bogs, or, where well sheltered, densely covered with screw-pines, or, where partially drained, supporting a thick growth of thorny plants and scrub.

The streams, having their sources in the hills after the burst of the south-west monsoon, and generally during the months of June, July, August and September, are torrents rushing over rocky beds, which on reaching the low flat lands unite to form perennial streams. In October there are often heavy showers sufficient to swell the brooks; but in November, December, January and February many of the sources are almost dried up, the waters of the main streams decrease in volume; and in March, April and May, the hot season, when dry harsh winds are not infrequent, and when the grass in the earlier part of the season is on fire on the hills, the tributaries of all the rivers exhibit a marked difference of character.

The smaller tributaries, the sources of the streams, have cut rather deep channels in the sides of the main range and the hills! the descent is rapid and the direction of each nearly straight; it is only when they unite and flow through the low level lands that they have a tortuous course.

The soils on the slopes are, where protected, moderately good and deep. In colour they are light reddish brown, brown, dark brown and nearly black, the latter having a fair proportion of decomposing vegetable matter. Elsewhere they are very thin resting on hard rock or on strong tenacious clays derived from the decomposition of the country rock *in situ*. These clays are but little affected by the heavy rains: the surface of them becomes glazed, and running water does not cut into them as it would do if they were arenaceous. Where cuttings are made, the clays stand for a height of fifteen feet or more perpendicularly, and, in some parts, even for a vertical height of fifty feet, the rains scarcely affecting the surfaces at all.

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* The figures here given are approximations only.

Clays however that have been moved, carried down by the rains, and re-deposited are, in comparison, rather easily disintegrated and washed away.

On the lower parts of many of the steep slopes the soil and stones carried down during the monsoons form distinct but irregular layers and (though rarely) strata somewhat resembling alluvial deposits. Heaps of gravel and partially water-worn stones accumulate in the beds of the torrents, where there is a sudden change of level, caused by a hard bar of rock or a fall of rock, and the torrents, as their beds are deepened and the courses are changed, have these loosely-formed beds as walls on one side or other, rarely at the same spot on both.

The numerous roads in the Wynaad at various heights and in many cases nearly parallel to each other, whether made by the Government for the purposes of general traffic or by the planters for convenient access to various parts of their estates are invariably well made, and the traces are good. They are sideling roads: the bank on one side of the hill is cut away and the excavated earth and rock are made to form a part of the road.

They are necessarily, in a hilly country like that of the Wynaad, contour lines, and the maps which accompany this report shew in what directions they run; and, in the absence of a correct orographic map, give some hints as to the general features of the country.

In cutting these roads very many fair sections of the rocks and some quartz veins have been exposed: and the mineralogist and geologist find at numerous points as they travel along them much that instructs both as regards the character of the country rock, its mode of decomposition and its conservation, as well as the rather peculiar character of the "leaders," "strings," and small veins which are, as it were, thrown off from the main reefs of quartz.

Rocks.—The granitoid schists or gneissoid rocks of South-East Wynaad are, it is probable, as will be shown hereafter, only completely metamorphosed sedimentary strata. The minerals observable are felspar, quartz, hornblende, mica, talc, chlorite, pholerite, and magnetic iron. The ordinary foliated rock is usually massive or composed of thin compact layers of quartz and felspar, or of quartz and hornblende. Magnetic iron takes the place of one or other of these constituents, or accompanies them in some places, and at and in the neighbourhood of Marpanpadi North Peak, magnetic iron is largely present in the rock, the decomposed surface stone exhibiting layers and reniform and nodular masses of sesquioxide of iron. Some specimens are composed almost entirely of quartz and magnetic iron, and in others the iron occurs with quartz and felspar; and again there is a variety composed of translucent quartz, magnetic iron, and an asbestiform mineral resembling iron amphibole.

Bands also have been observed in which the proportion of iron pyrites in disseminated crystals is very large.

Massive hornblende rock is found on the south-east, and garnetiferous foliated gneissoid rock is common towards the north and east.

In many places the country rock, besides being intersected by large persistent reefs of quartz, is seamed and veined throughout with threads and strings of quartz; not in any way conformable to the lines of foliation; and where a section of the rock decomposed *in situ* is laid bare, these threads and strings are clearly traceable through the red, reddish brown, and dark brown of the kaolin-like clays resulting from the decomposition of the stone. These veins vary from one-eighth of an inch or less to six inches or more in thickness, and they consist either of white opaque or blue opaline quartz, the latter not unlike that which forms thin layers in the foliated country rock.

In more than one locality near Devála, the harder rocks consisting of dense quartzite or quartz with magnetic iron and a little felspar appear as large rhombohedral blocks or as symmetrical hexagonal or square prisms; and the faces of the planes are not seldom covered with thin layers of rather dark blue opaline quartz. Many of the forms are of singular interest, and a stranger might without examination suppose that some of the masses were

of igneous origin. It is perhaps needless to say that the shape of these blocks is due to the direction of the several systems of divisional planes or joints.

The modes of decomposition of the several varieties of gneissoid rocks in the Wynaad give hints as to the degree of metamorphism to which they have been subjected. For instance, where not intensely metamorphosed, they do not weather into spheroids nor exhibit concentric layers around a hard core of rock, such as one sees in tracts occupied by granitic, trappean, and the older igneous rocks. Where, however, there is a greater development of the crystalline structure, as in some parts of the country west of Devála, this well-marked feature presents itself.

East of Needle Rock and east of Harewood thin micaceous shales occur which remind one of the typical micaceous lower Silurian rocks; and the lines of lamination in the former might well seem to correspond with the cleavage planes of the latter. The strike of these thinly laminated micaceous shales east of Needle Rock is N. 55° W., being nearly at right angles to the general direction of the folia of the gneissoid rocks. It is perhaps correct to say that observation has shown that the most productive auriferous belts in the Wynaad are those in which these micaceous and chloritic rock occur; and that as a rule where the hard dense massive quartzo-hornblendic strata are found, and where the foliation is indistinct, the veins are either absent, or, where present, consist of saccharoid quartz with large and small plates of mica.

The foliation of the rocks in that part of South-East Wynaad already described preserves throughout a nearly uniform strike, namely, N. 54° E.—S. 54° W. There are curves however where the direction varies from N. 40° E. to nearly east and west. The dip is southerly and south-easterly from 60° to vertical.

Only an extended examination of the country, such as would be made in the course of a minute geological survey, would enable the observer to offer suggestions as to the probable origin of these metamorphic and metamorphosed rocks. It is apparent wherever they are well exposed that there is one system of planes very like strike-joints which, but for the direction of the dip, might be supposed to represent planes of original deposition. The direction of these in some degree accords with the general direction of the main quartz veins, and it might be surmised on a first view that the formation of the latter was due to the same forces which operated in altering the strata they intersect; that, in other words, the quartz in the veins was segregated during the enormous period which elapsed from the time of the first slight alteration of the original sedimentary rocks until they were metamorphosed as we see them now.

In the *Manual of the Geology of India* it is stated that "this Nilgiri strike is noted as distinctly that of the lamination and bedding of the gneiss as well as of the foliation," and therefore it is the more difficult to conjecture to what forces the direction of the quartz veins is due, coinciding as it does, not with the foliation, but rather with the system of joints above referred to.

While the strike of the rocks over a large part of Australia is nearly meridional, the reefs also have generally a north and south direction.

The stronger and more persistent veins as they appear at present may represent what were once lines of least resistance, and some speculations of a strictly geological character might follow this suggestion if this report were not confined to questions of a practical character.

Much valuable information is to be obtained respecting these rocks from the reports and map prepared by Mr. King. A sketch of a geological map of South-East Wynaad on the scale of four miles to one inch, published with the records of the Geological Survey of India (May 1875), and which I had not the opportunity of seeing until after much of this report was written, shows alternating bands of felspathic gneiss and chlorite gneiss running north-easterly and south-westerly, as well as a large area occupied by quartzo-horublendic gneiss (Nilgiris) and the smaller areas of granitoid gneiss at Yeldakilmullay and Munnaymulla.

There is an absence of intrusive rocks in South-East Wynaad. There are no dykes or masses of porphyry, no basalts or recent volcanic rocks ; and it is only at one point, as far as is known, where greenstone occurs, namely, on the Hamsluck estate. The rock consists mainly of hornblende with a small proportion of felspar (oligoclase).

Near the spot where this rock is exposed there are veins of granite, or perhaps, to speak more correctly, veins of quartz which are essentially granitic. In several places, more particularly at Gúdalúr, Cherambádi, Moopenaad, and Vellirymulla there are masses of quartz with large transparent plates of mica. The micacisation of the quartz is observed most frequently (but not invariably) where the veins are very thick; and from the observations which have been made up to the present time it might be inferred that gold, in such proportions as it is found in veins which are free from mica, is rarely present in these micacised reefs.

It is not yet certain that the "country rock" is commonly less silicious in those places where the quartz veins are numerous, but this peculiarity is to be noted in the neighbourhood of Devála.

General character of the auriferous quartz veins.—The quartz veins of the Wynaad differ in some respects from those intersecting the almost unaltered lower Silurian rock of Australia, but they are usually as thick, or thicker, and quite as persistent. The auriferous veins, those which have yielded well both on the large scale and by tests in the laboratory, are laminated and more or less pyritous, and those which up to the present time are regarded as less auriferous are composed of saccharoid, often snow-white opaque quartz with transparent particles of quartz impacted, and have generally an obscurely granular appearance—more indeed like quartzite than vein-quartz, and in many places, as already stated, they exhibit a tendency to become grantic, large plates of muscovite and apparently a hydrated muscovite in smaller plates, with here and there a little felspar giving them a character which separates them at once from the well-known rich pyritous veins near Devála. Some of the massive quartz near Moopenaad and Vellirymulla micacised and in structure simulating granite, or partaking of the character of the country rock, might well be supposed to be bedded and not vein-quartz, and contemporaneous with the gneissoid rocks with which it is associated. There was no true quartzite seen in these places, but it may be conjectured that the induration and alterations of composition and structure, which have resulted in the formation of the foliated gneissoid rocks would not be without influence on purely silicious granular interbedded masses.

From the larger (true) veins "leaders" are thrown off, most commonly to the westward. The leaders usually dip at a low angle, but in some places they are so large and of such a form as almost to give the character of "saddle" reefs to the masses of quartz.

The ordinary "casing" of the reefs is a talcose schist (easily separable into thin laminæ) with oxide of iron and the minerals ordinarily therewith associated ; and gold in small flat particles, visible to the eye, is not rare in the casing. The casing of many of the large auriferous reefs is quartzose and ferruginous, rudely laminated and with scales of ripidolite and talc scattered through the mass.

The average thickness of the true quartz veins is about five feet. Some are less than two feet in thickness, and others again exceed fourteen feet. The greater number, however, vary from four to seven feet. The direction of the veins is usually N. 30° W.—S. 30° E., and some are nearly due north and south; and the dip, though nearly always easterly, is irregular. On the summits of the steep hills the veins are commonly almost flat or with a very slight dip to the eastward, but at a little depth from the surface the dip is, as might be expected very different. It is not seldom as much as 30°, 40°, and 60°.

These sudden variations may be due partly to the changes produced on the surface by the heavy rains which fall yearly. Much decomposed and almost solid rock is moved in masses, and "the action of gravitation on

substances loosened by weathering, or the 'weight of the hill' as it has been called, would account for the difference of dip as measured near the surface and at some depth from the surface.

The direction or strike of the quartz veins is, in a district like the Wynaad, broken up, as it is, into rounded hills of varying height not easy to trace, unless regard be had to the elevation of each point where an outcrop of quartz is seen. An outcrop on a hill is thrown to the westward, and the same reef outcropping in a valley is necessarily eastward of the line which would appear if the ground were of the mean level.

It is not yet possible to say what number of separate veins of quartz there are in the area which has been examined, but there are at least two hundred outcrops—not necessarily distinct reefs.

From Moopenaad to Cherambádi, a distance of eleven miles and-a-half by the road, twenty-three outcrops were observed, many of them indicating reefs of great thickness; from Cherambádi to near Nadukani in a straight line south-easterly, twelve miles, there are at least eighteen separate veins; and east and south-easterly of Devála the reefs are from 5, 5½, 7, 10, 16 and 23 chains apart.

Between Moopenaad and Cherambádi the rocks are in places arenaceous.

Distribution of Gold.—As will be seen from the detailed reports which follow, gold is almost universally distributed throughout the soils and quartz veins of the Wynaad. It occurs also in the sands and soils both on the east, west, north and south.

In South-East Wynaad, on washing a few dishes of the surface-soil anywhere, a few specks of very fine gold will be found; in the vicinity of the reefs rather heavy gold is often got by sluicing; and if a suitable spot be selected, the native miners will obtain, even by their methods, sufficient gold to remunerate them for their labour.

The character of the rocks, the nature of the climate, and the formation of the country have all contributed to prevent the accumulation of drifts such as are found in California and Australia. There are here no gullies having in their beds shallow deposits with a well-defined auriferous stratum, no "deep *leads*," covered and protected by layers of volcanic rock; there are only, as a rule, in the district now under consideration "surfacing" and "quartz-mining."

On the Seeputtee river there is an accumulation of well-rounded boulders of quartz and gneissoid rock imbedded in hard clay and sandy soil which may be regarded almost as a "cement." It is no more than the old bed of the river, which owing to the "cutting back" action of the water has lowered its level and left this drift on its banks. It is probable that, as in other similar cases, the "cement" will be found in patches on both sides of the river, in places which were formerly bends of the old stream. The bed-rock on which the gravel, clay, and boulders lie is at no great height above the level of the existing water-course; and the part of the drift which has been worked is about thirty feet in thickness,

This drift and those which are to be found in the beds of the swamps may be said to represent the alluvial deposits of the Wynaad. Some of these are probably rich in gold, but it is only under favourable conditions that they could remunerate the miner.

It would be extremely difficult and costly, and in many cases almost impracticable, to drain the swamps by artificial channels, and the expense of pumping the water from a shaft would be very great. Still, if the lowest stratum should prove to be highly auriferous, it might be found remunerative to resort even to pumping, care being taken to carry off the surface water from the swamps by constructing races.

Below the Wynaad platean and bordering on the tertiaries there are in the beds of the streams rather deep deposits of drift. At Karambaut the water-worn gravels and rounded blocks of country rock and quartz are of considerable thickness.

Below Eddacurra the bed rock is covered with quite recent deposits and

tertiary strata (laterite). It is not known whether the stratum immediately overlying the bed-rock is generally auriferous; but wherever the latter is intersected by quartz veins, more or less gold will be found in the disintegrated rocks.

Mining for gold in Malabar in former times.—From the appearance of the mines and the soils on the slopes of the hills, it is almost certain, as stated elsewhere, that gold was worked in Malabar at a very early period. This, however, is only conjecture. The industry has no history. The wealth of the native rulers in former times, the buildings erected by them, and the records relating to their wars all point out however to the conclusion that gold was derived in large quantities either from the Peninsula or perhaps from some neighbouring country.

Ground-sluicing.—In getting gold by "ground-sluicing" the Korumbars display much ingenuity. One old miner usually directs the operations. Having fixed on a spot where he thinks there is a probability of finding gold he "prospects" the area, using the *murriya* for washing the earth.

On a site being chosen, if it is not actually in the bed of a stream, a supply of water is directed to the spot by a race, and work is commenced. The men excavate the earth with their mamoties, the water all the while flowing over the space in which they are working. One man stands behind the other at such a distance as to permit of his using his mamoty, and in a short time three or four men are laboring knee-deep in water: the large stones are put aside, so that finally a wall is formed. The men are usually careful in washing the stones, and they exhibit no little skill in turning every slight advantage to account. The soil is stripped to the bed rock, every crevice is scraped with the mamoties, and at length the resulting heavy material having been concentrated by being raked up against the stream, the old miner steps into the channel with his *murriya* in his hand and fills it with the sand, &c., piling the stuff as high as he can on the dish. A little pool meanwhile having been made he places the wooden vessel with its weight of sand in that and "puddles" the sand, always scrupulously washing and examining the small stones before he throws them away. By tilting the dish and adroitly moving the stuff with one hand as the water flows over it he finally obtains a black, heavy, iron sand, and on this being sufficiently concentrated, the vessel is filled with water, a swinging motion is given to it so as to throw the gold into or a little above the hollow in the centre, and then again tilting the *murriya*, he takes water in one hand and allows it to fall through his fingers on to the sand in the lower part of the dish, and thus in a little time clears the dish of the refuse, and at length is able to show the gold almost completely separated from the black sand.

The washing is continued dish after dish until all the material concentrated in the sluice has been treated. The Korumbar's skill in manipulation is very great and he is also patient and painstaking.

When the gold is got together it is put into a leaf, and any black sand in it is washed off.

The operation of washing a dish of stuff usually occupies half-an-hour or more.

The *murriya* is made of hard, heavy wood. It is from eighteen to twenty-two inches in length, sixteen inches in breadth, and from two to three inches or more in depth. There is a projecting pin at one end and a knob at the other. It becomes smooth and black by use and shows the smallest particle of gold quite clearly.

In many parts of the Wynaad District the remains of the walls built by the miners when ground-sluicing, the lines of their races, now almost obliterated, and heaps of rubble extending in some places over many acres, are to be seen; and in the jungles on cutting into the earth on a hill side, one finds that the soil has been disturbed. Indeed the evidences of the patient labor of the native miners are so numerous and are found in so many localities that one pauses to consider the length of time which must have elapsed since gold-washing first became an established industry in this part

of India. The soil and rubble made to yield its gold in times long past is now again consolidated, covered with herbage, and supporting large jungle trees.

Washing with the pautty.—The box used by the natives for washing auriferous earth more resembles a puddling through than a sluice. The *pautty* is a trough made of wood. It is from six to seven feet in length and one foot or more in breadth. On discovering a spot where there was a sufficient quantity of auriferous earth these boxes were employed; and it would seem from the report of a Committee appointed, under date 14th December 1832, to examine the gold mines in the Zilla of Malabar, that when they visited the mines near Mambat (Beypore river) there were fifty or sixty Moplahs at work.

The Committee state that the *pautties* were placed over a running stream; or water was conveyed to them in races. The boxes were placed in a sloping position. At the lower end small pieces of bamboo were laid across which acted as "riffles." Two men, the Committee state, were required to work one *pautty*. One day they collected the earth and the next day they washed it. The earth was carried to the *pautty* in the *murriya*, and the men stirred the earth with their hands, removing the stones, &c., until only heavy sand remained. This residuum was washed in the ordinary way in the *murriya*, and quicksilver was used to collect the gold, the amalgam being afterwards wrapped in a rag and placed between two pieces of burning charcoal until the heat volatilised the mercury and left the gold clean.

The *pautties* were used during the wet season on the higher lands, and in the dry season in the beds of the streams.

Working veins.—Throughout South-East Wynaad and at several places in the low country of Malabar the quartz veins have been worked by the natives. The appearance of the workings indicate the following methods of getting out stone:—

(1) Quarrying on the outcrop of the veins (surface workings).
(2) Vertical shafts.
(3) Adits.
(4) Vertical shafts with adits therefrom.
(5) Shafts on the underlie.

Quarrying on the outcrop of the veins was undoubtedly followed in the first instance. Gold was seen in the stone, and blocks were broken in order to procure fragments with gold visible. It is believed that no stone was crushed which did not show gold.

Subsequently vertical shafts were sunk, but by what tribe is not known. Many of them are well formed, always round, and as deep as seventy feet or more. Some are in solid quartz, others in country rock intersected by "leaders" and thin veins of quartz. How the miners could possibly have sunk such shafts in hard dense quartz with the tools they had is hard to guess. They are plumb and the sides are quite smooth. It is not uncommon to find a number of shafts very close together, not more than a few feet apart. The adits in most cases were evidently constructed long subsequent to the sinking of the vertical shafts; where the latter are found on the summit of a hill, they are undercut by adits; and in some places care has been taken to block up the shafts so as to prevent stones and earth falling in on the miners below. It is unreasonable to suppose that several vertical shafts would have been sunk close together after the adit was driven. They could not have served any useful purpose. And the miners who constructed the adits did not generally sink vertical shafts in following the reefs downwards from their adits; they sunk shafts on the underlie or foot-wall, and these are to be seen in various places.

Towards the north-west another system was employed. In mining on the steep slope of a hill a vertical shaft was sunk to the depth of six or eight feet so as to cut the reef, and an adit was driven therefrom. With what object this method was adopted is not known; but it may be supposed that in some situations difficulties were found in protecting an open cutting

from the rains. A cutting necessary to get a "face" in the solid rock would present surfaces which would be to some extent affected by the rains; whereas by sinking a shaft (at all times easily protected) the miners were able to penetrate the hill with safety, though the additional labor involved in getting out stone would be great. There are, as already stated, not a few shafts sunk on the underlie in several localities near Devála. The reefs were mined in this manner, it is almost certain, by the same class of miners as made the adits.

It was not unusual for them to penetrate to the depth of sixty or seventy feet, but where the reefs were flat or had a low dip, these underlie shafts were only inclined adits, rising where they worked at the casing of the hanging wall and falling again as they followed the foot-wall.

In what manner soever the auriferous quartz was procured the after-treatment was in all cases nearly the same. The quartz broken into small pieces was given to the women to grind. Each woman was provided with a muller or hand-stone, and the fragments of quartz were either ground on a suitable piece of stone *in situ* or on a large flat stone procured for the purpose. The pounded stone was subsequently washed in the *murriya* and the gold got by amalgamation with mercury.

The auriferous stone was sometimes roasted. Whether merely to effect its disintegration more easily and rapidly, or whether from a knowledge that the pyrites in it were auriferous, has not been quite satisfactorily astertained.

It is probable, however, that some of the miners knew that the pyrites contained gold though it was not visible to the eye, and that by roasting the mineral they would get it. In one locality it was usual for the miners to procure blocks of pyrites, divide them, and take the pieces to their homes for treatment.

In breaking up blocks of quartz too on the outcrops of the reefs, it is said that they used fire. In one place, according to information given to me, the trees of the jungle were felled, the timber piled in heaps on the quartz and there burnt, and on the outcrop of one reef an excavation in the solid rock was found which appeared to have been constructed for and used as a kiln.

Where the quartz miners have labored there are to be seen usually large heaps of broken quartz, the pieces rejected, because they did not show gold; and on the outcrops of the reefs are found the smooth hollows in the rocks worn by long hand-grinding, while in the jungles, the flat stones and mullers, covered with moss, are occasionally met with.

It may be interesting to remark that these flat stones and mullers are very similar in form to those used by the Australian natives for grinding seeds, &c.

The miners who worked in the adits seem to have had more knowledge of mining and of the modes of occurrence of goid than those who formerly got out quartz by sinking vertical shafts. The former followed the run of gold wherever they were able to do so, sometimes taking out the foot-wall and "casing" and sometimes the hanging wall.

The Korumbars, skilful as they are, have no knowledge of the manner in which the gold has been distributed. They are acquainted with the "run" of the reefs and show great intelligence in selecting spots likely to yield gold, but they do not believe that the gold in the soils has been derived from the disintegration of the reefs. They say that it is found in some places in the reefs, in other places in the soils, but that its occurrence in the latter is in no manner connected with the former.

Machinery for treating auriferous quartz, &c.—The machinery and appliances for crushing auriferous quartz and saving gold are simple in themselves and easily managed when the principles on which they are designed are understood. Neither that portion of the work of reduction which is purely mechanical, bringing the mineral into such a state as to admit of metallurgical treatment, nor the metallurgical treatment itself is of such a character as to call for more than the knowledge which is to be gained in any large quartz-

crushing establishment. A competent superintendent may not be an engineer nor a chemist, but he should have a sufficient acquaintance with mechanics and mechanical processes, and he should be familiar at least with the chemistry of the metals and minerals with which he has to deal.

The machine for crushing quartz consists of a series of stamp-heads arranged in batteries of four or five. To each stamp-head is attached a lifter with a circular disc. A horizontal shaft, provided with wipers (so placed as to catch the discs) when put in motion causes the stamp-heads to act as so many pestles. The wipers are arranged in such a manner as to make the stamp-heads in each battery fall successively, but the order in which they fall is not the same in all mills; and each stamp-head rotates, making part of a revolution each time that the wiper catches the disc.

The stamp-head moves in an iron box or coffer having spaces covered with perforated plates for the passage of the crushed quartz. The bottom of the coffer is packed with broken quartz to the depth of three inches, and on the broken stone lies the false bed of wrought iron.

In the best mills the stamp-head with its shank or lifter weighs from 6 cwt. to 8 cwt., in some the weight is as low as 2 cwt., and in others as high as 9 cwt. The height the head falls varies from 6 inches to 15 inches, and in the number of blows per minute there is a wide range; in one mill the number may be no more than 45, and in other 85.

Connected with the mill there ought to be one or more machines for breaking the blocks of quartz into small pieces. When the quartz is brought to the mill, the smaller pieces are picked out and sent direct to the stampers, and the blocks to the stone-breakers. A stone-breaking machine will break about eight tons of quartz per diem. As the price of labour is very low in India, it might be practicable to have all the stone broken by hand, but the saving effected (if any) by employing manual labour would be very small.

A self-feeding apparatus is almost indispensable. It not only saves labour, but also ensures regularity in feeding.

The water trough is usually placed under the self-feeding hopper.

In front of the coffers are three or more troughs containing quicksilver, and below these are the tables. The tables should be evenly and securely fixed and in such a manner as to admit of the inclination being altered if necessary. They should be at least twenty feet in length. The strakes (subdivisions of the table formed by fastening narrow strips of wood to the floor) should be about fourteen inches in breadth. In all well-planned mills there are breaks in the tables, generally at intervals of three feet, the upper edge of the lower strake being about two inches below the slightly overlapping edge of the one above. The tables should be made quite smooth, and the utmost nicety is required in setting them, so that the inclination may be the same throughout, and any line at right angles to the strakes absolutely horizontal. The same care should be employed in putting on the blankets; they should lie flat and cling to the boards.

Closely-woven green baize is perhaps the best material for blanketing.

At the extreme end of the tables there is another trough containing quicksilver, and finally a waste trough through which the sand, pyrites, lime, &c., pass to settling boxes.

The boxes are cleaned out from time to time during the working day, often at intervals of a few hours.

The separation of the pyrites from the sand &c., constituting the tailings is now generally effected by some form of buddle.

Borlase's buddle with Munday's patent scrapers is believed by many to be the best. It consists of a circular wooden trough or basin from eighteen to twenty-four feet in diameter. It is about one foot six inches in depth. The tailings consisting of crushed quartz, pyrites, &c., are made to pass along a sluice and fall into a box whence they are conveyed by pipes to the sides of the trough. The greater specific gravity of the pyrites causes the mineral to separate from the quartz sand and to remain on the floor of the buddle,

while the latter being carried down the table passes away through a discharge pipe. In order to prevent the loss of the valuable material, two or three rims or stops are fixed on the floor of the basin. The pyrites are raked by knives, which, as well as the pipes conveying the material to the trough, are made to revolve round the central shaft. A machine making seven or eight revolutions per minute is recommended. The knives are raised or lowered by means of screws.*

The concave buddle has had the attention of mechanical engineers for some years, and several improvements have been adopted from time to time. Other ore-dressers have also undergone modifications with a view to fit them for the use of the gold miner, and some forms of percussion tables have given good results.

The pyrites, however excellent the system of concentration may be, are never entirely free from a certain proportion of quartz sand; but this is not to any serious extent objectionable when the material comes to be roasted in the furnace. Numerous forms of furnace have been devised for roasting pyrites; one kind after another has been tried, and it has been found in this as in all other appliances for treating auriferous pyrites and auriferous quartz, that the simplest plan is invariably the most efficacious. An inclined reverberatory furnace on the following plan is highly approved of in Australia:— It consists of a fire-box from which the heat and products of combustion pass over a hearth into condensing chambers. The charge is supplied through a hopper and gradually drawn down over the hearth by rakes until it reaches a channel near the fire-box, whence it is drawn into a pit at the side of the furnace. Four or five small doors are provided into which the rakes are inserted. As the charge is drawn downwards to the bottom of the hearth it becomes gradually heated more and more, and to such a degree as to decompose the sulphides. The roof of the furnace over the hearth should be arched.† In a well-constructed reverberatory (oxidating) furnace all the sulphides thrown into the bed are completely decomposed in a short time.

A dull red heat is maintained throughout, and until the sand is actually raked out into the pit, there is a continuous stream of heated air playing upon the pyritous minerals.

Methods of testing auriferous quartz and auriferous pyrites.—Only by a careful chemical analysis can the proportion of gold in any given quantity of quartz, pyrites, or other mineral be ascertained; but for all practical purposes, assays by amalgamation are sufficient. The methods pursued in treating quartz taken from the reefs in the Wynaad have been as follows:—

When a reef was tested in sections, the stone from each section was taken out in far larger quantities than were required for testing; each heap of quartz was broken into small pieces, and the whole was well mixed, and from the heap so mixed the portion to be treated was taken. The stone was broken still smaller and weighed, and it was then ground very fine on a suitable stone, another stone being used as a muller. The finely pulverised stone was put into a clean iron pan and roasted until fumes were no longer given off until it was certain that it was in a fit state for amalgamation. If after roasting the pulverised material seemed to require it, it was again ground on the stone. The heat at all times was so regulated as to prevent the possibility of "glazing."

The roasted stone was put into an enamelled dish, and a proper proportion of quicksilver was added.

The whole was then thoroughly rubbed by hand, at first dry; subsequently a little cold or hot water was poured in until a paste was formed; more water was added, the stuff being thoroughly rubbed all the time, and

* A description and a plan and section of Borlase's buddle are given in the Report of the Board appointed to investigate the methods of treating pyrites in Victoria. And descriptions of other forms of buddles are contained in the "Gold Fields and Mineral Districts of Victoria."

† Report of the Board appointed to investigate the methods of treating pyrites, 1874.

finally the amalgam or (if there was no gold) the quicksilver was washed off, the utmost care being taken to prevent the loss of any quicksilver. The water and sludge from the enamelled dish were poured into other vessels, and these were most carefully examined subsequently, and if there was doubt,—and sometimes when there was no doubt as to the results, the sludge-sand, &c., in these were treated again,—the amalgam or quicksilver was most often placed under the flame of the blowpipe, but at other times nitric acid was used and the gold (if any and of sufficient quantity) was weighed.

The results were calculated in the ordinary way.

It happened occasionally that the roasting was not sufficiently protracted, or that all the material subjected to the roasting was not ground as fine as it ought to have been, and then it became necessary to subject it to further roasting, or to use acids to decompose the sulphides. In all cases the utmost care was taken to preserve the conditions necessary for effective amalgamation.

The quartz collected in various localities was treated in the same manner as that taken from sections of the reefs.

In order the better to illustrate the value of this system of testing quartz, I took a quantity of sludge and sand from which the gold had been extracted, and which had been saved in pans, and into this I put half a grain of very fine gold. The gold was well mixed with the sludge, &c.,—quicksilver was then added, and the operation of amalgamating performed in the ordinary manner. The amalgam was treated also in the ordinary manner, and the gold recovered weighed ·4786 grains nearly, showing that the loss was 4·28 per cent. The loss may be partly accounted for by the mere handling of the fine gold in a very damp atmosphere, *i. e.*, weighing it, transferring it to the dish of sludge, &c., and re-weighing it. This system however is, when very carefully managed, so certain, that if the actual assay produce of a parcel of quartz was at the rate of one ounce per ton, the gold got by amalgamation would weigh 19 dwts. 3·5 grains. It will be observed that the result in every case must necessarily be slightly in defect, never in excess. Messrs. Johnson and Matthey, the well-known Analytical Chemists, in a report to the Directors of the Port Phillip and Colonial Gold Mining Company, make the following statement:—

"We finally had recourse to amalgamation, and were surprised at the ready results so obtained (having been led to suppose that the mineral—pyrites—was unworkable under that process) * * * * * * The results recorded by the Analysts are highly interesting:—

	oz.
The pyrites (raw) gave by 'assay'	11·425
Obtained by amalgamation	10·400

"The pyrites exposed to the decomposing influence of the atmosphere from 15 to 20 days being laid out in a thin layer and occasionally stirred:—

	oz.
Assay	11·425
Obtained by amalgamation	10·850

"The pyrites calcined in an ordinary calcining furnace slowly and at a low temperature:—

	oz.
Assay	11·400
Obtained by amalgamation	11·275"

The loss by the amalgamating process was in the first experiment 8·97 per cent, in the second 5·04 per cent, and in the third 1·1 per cent.

MINERALS OF THE SAN FRANCISCO VALLEY, BRAZIL.

(From the *South American Journal*, May 12, 1881.)

The following is taken from the report of Col. W. Roberts :—

Gold.

Almost all the basin, from Piranhas to the heads of the river, is known to be auriferous, and perhaps no region of the world has undergone so many trials as those parts of the basin which belong to Minas Geraes and Goyaz, wherein a great extent of the surface has been literally turned over in quest of the precious metal.

To judge by the appearance of the country, and the bad success of many recent attempts, the gold of the region is exhausted. But, without being able to form an authoritative opinion, my study of the matter having been too limited, I am far from supposing such to be the case. At least the ill-success of many promising undertakings should not be taken as proofs, inasmuch as many causes co-operated therein and they should be attributed largely to the difficulties of communication, to ignorant and extravagant administration, and to the ruinous speculations which have induced abandonment of the undertakings before the mines had been properly tested.

Gold appears in many modes in almost all kinds of rocks in the region, but for mining it is enough to treat of four of the modes, namely ; pyritous veins, quartzite ones, beds of ferruginous quartzite known as itabirite, and superficial gravels and sands.

The known and worked veins of pyrites are those of Morro Velho, Cuyaba and Santa Barbara, in Minas Geraes. At times they have a great width (20 metres at Cuyaba), and, though not extremely rich, are very steady in value. Their gold is exceedingly fine and of difficult separation, requiring careful treatment and costly reduction.

The average value of the Morro Velho mineral is only about eight oitavas to the ton, but, being judiciously administered, this mine has been rendered, not only the best in Brazil, but one of the best in the world.

As yet the pyritous veins have proved to be the best when, as at the three places mentioned above, there is good management, and great quantities of ore have been extracted from them and treated. Their secret is economical work on a large scale, and, doubtless, there are many places where similar mines could be opened.

The veins of auriferous quartzite are more numerous but are smaller than those of pyrites. Many were worked in early times, and I believe there are some now in work.

The veins hitherto opened are of very variable thickness and inconstant richness. Some places have been found extraordinarily rich, but they were soon exhausted, and none of the mines have been steadily prosperous.

The same can be said of the mines in the itabarite beds, in which the gold is usually distributed along certain lines. The famous mines of Congo Secco and Machiné are instances of almost fabulous richness in certain parts of these beds, and of the inconstant character of the auriferous lines.

Besides the irregular distribution of the gold there are other difficulties to overcome in such mines. The rock is so porous that they are frequently liable to inundation, and so loose and friable that even with the most solid timbering it is difficult and costly to keep the galleries open. It would be worth while to try working these beds with a jet of water, as in California, as I am convinced by the experiments I have seen, that the material could be rapidly and cheaply excavated by that system. The only embarrassment is that the great specific gravity of the ferruginous sand would render the separation of the gold difficult by the common processes, but, probably, means of getting over this difficulty could be invented. Should the application be successful, new horizons would open to mining.

The superficial deposits are those which have been most extensively worked They lie in great abundance in the valleys and extend along both sides on the hills. Great sheets of gravel, covered with more or less soil,

show themselves likewise on the hills and mountains at a distance from the streams, and appear due to denudation and not to surface waters. No valleys of ancient rivers like those that characterise California have been recognized, and there are no proofs of the action of the causes which produce such deposits by change of the old system of drainage.

Using the old system of dish and canoe, it may be said that in general these deposits are exhausted, and they have all been abandoned. Still, it is a problem to decide whether they could be worked profitably with modern methods. The old miners, though they employed a slow and tedious process, had the advantage of disposing of exceedingly cheap labour, and it has to be proved that modern miners could remove and wash a given quantity of gravel as cheaply.

It is a mistake to suppose that the ancient miners did not understand and use the action of running water in their mining. The hills of Minas Geraes are grooved with old ditches, often leagues in length, and therefore comparable with modern hydraulic works. What they did not understand was the great advantage of the hydraulic system—that of bringing the water *under pressure*.

The region presents great facilities for the employment of this modern system of mining, and it is probable that there are places where it could be applied profitably, for it is another mistake to suppose that there are not remunerative places to be discovered and worked, and that all those worked and abandoned were exhausted or judged so by the miners. History here shows that mining always dragged on a precarious existence, because of the foolish repressive laws of the Portuguese Government, and, indubitably, frequent abandonment took place of promising places whose working was not renewed when the restrictions were taken off.

The possibility of discovering new virgin deposits has been shown by the recent discovery of a rich diamantine deposit at the Jequitahy. No region was so prospected as was that lying west of Diamantina by the "garimpeiros," or "diamond poachers," who, driven like wild beasts from the diamond demarcation, spread all over that region, trying the ground everywhere in search of gold and diamonds, yet up to 1874 the richness of the Jequitahy was unknown.

The foregoing observations apply especially to Minas Geraes, with which I am best acquainted, but there is no doubt they are as applicable to Goyaz and Bahia. Traditions of immense riches are common in both provinces, and, allowing for exaggerations, there is certainly much to be explored. The valley of the Rio Verde, in the comarca of Chique-Chique, Bahia, is one of the most famous in the traditions. With facilities of communication, a good mining law, an active and enterprising population, and, finally, application of the most improved systems of mining, the auriferous deposits of all kinds existing in the basin of the San Francisco may yet again vindicate their primitive fame. The Ouro Preto Mining School should, if properly supported, contribute greatly to such result.

Ceylon Gems.—With reference to your paragraph under the heading "Probable Increased Demand for Ceylon Gems," which appeared in your paper of the 4th instant, you will probably be surprised to learn, that there has been an utter absence of demand in the London market for Ceylon precious stones for some considerable time, owing to the continued large receipts of blue sapphires from Burmah. A parcel of blue sapphires and cat's-eyes, which has been in the hands of a first-class London house for some time, and which had been valued at over £1,000 eighteen months ago, has now been, owing to the stupid policy of holding, re-valued at only £250!! and it is most difficult to get a bid even at this figure.—*Cor.* "*Ceylon Observer*," June 10th, 1881.

OF THE PEARL FISHERY ON THE COASTS OF CEYLON.

(*From Ribeyro's Ceylon by George Lee.*)

Having now related all that we know of the natural riches of the land of Ceylon, we shall describe those which its sea produces. The pearls which are procured from the coasts of the island, and more especially from Aripo, are of the highest value. As few persons know how that fishery is conducted, we shall here relate what we know of it.

At the beginning of March there assemble on that coast 4 or 5,000 boats got together and paid by Moorish or Heathen merchants and by some Christians. These merchants have many partnerships among themselves, and they first make up a fund to arm four, five or six boats, more or less, according as the entire adventure is greater or smaller. Each of these boats has generally from ten to twelve sailors, one master, and eight or nine divers. All the boats go out together, and seek when the fishery is likely to be most profitable: and they anchor at the spots where the sea is only five, six, or at most seven fathoms deep. Then they send off three boats to a league distant round-about, each in a different direction; each of these boats brings back a thousand oysters. These are opened in presence of the merchants, and the pearls found in them are examined by the whole party and their value estimated, as the pearls are much finer in some years than in others, and accordingly as the merchants find the pearls to be large, clear, round and of good water, they bargain with the king for the fishery of that year. When the bargain is made, the king usually gives them four vessels of war to defend them from the Malabar and other pirates.* Then each merchant goes to the sea-side and constructs a sort of enclosure with stake and thorns, only leaving a narrow passage for the boats to enter and go out again, which come there to discharge the oysters they have fished up.

On the 11th of March, at four in the morning, the officer in command of the four vessels of war fires a gun as a signal, and immediately all the boats put off to sea, steering for the place which they have selected to fish at and casting anchor there. Each of these boats has on board stones of the weight of sixty pounds each, fastened with strong ropes, of which one end is attached to the boat. The diver places his foot on one of the stones, and passes another rope round his body, to which is tied a basket or a small woven bag like a net; this second rope is held by two of the sailors, and the diver thus secured descends into the sea; he remains there whilst two *credos* can be said, and fills his little bag or basket with oysters, which he sometimes finds in heaps on the rocks; as soon as his basket is full, he makes a sign by pulling the rope held by the sailors in the boat, and one end of which is round his waist, and they draw him quickly out of the water; but if in the time he is below, he can contrive to open an oyster and finds a pearl in it, it is considered his own; as soon as his head is above water, another diver goes down, and thus they descend by turns. This fishery lasts till four in the afternoon, when the officer in command fires another gun as signal to cease the fishery for the day. Then all the boats go to their several enclosures, and the noise and confusion that ensue in the two hours that are allowed to discharge and pile up the oysters, cannot be described.

Besides the people belonging to the boats, the children of the neighbourhood never fail to assemble at the sea side offering their services, rather however to steal the oysters than to assist the sailors or merchants. As soon as the boats are unloaded, they put to sea again, and go about half a league higher up by the sea-side, when the merchants assemble and hold a splendid

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Note by the French Editor.

* An escort of armed men always accompanies the Pearl-divers, on account of the Malabars, who come from the coast of that name or from the Maldives, and who live by piracy, so that no boat, canoe or práhu is safe in those seas. The fishers or divers cease their work at noon, on account of the swell caused by the wind, and which annoys the divers, who can only descend in calm weather.

fair; there are magnificent tents, and all sorts of merchandize of the most valuable kind are to be had there, as vendors come from all parts of the world. Heathens, Jews, Christians and Moors, all have some speculation for profit; some sell by wholesale, others by retail; the sailors and children bring the pearls which they have stolen, and people of every kind have bargains to offer. Persons having but a small capital, buy small ventures, which they immediately sell to larger merchants with a middling profit; not only pearls are bought and sold, but jewellery of every kind, bar-gold, dollars, fine Turkey carpets, and beautiful stuffs from India.

The fishery lasts from the 11th of March to the 20th of April, but the fair itself continues for fifty days, because for the last nine days the enclosures are cleansed, as so many flies are bred by the corrupt matter, that the adjacent places and the whole country might be annoyed by them, if care were not taken to sweep into the sea the impurities collected during the fishery.

On the last day of April, the merchants of the several partnerships assemble together and share the pearls belonging to their respective boats. They separate them into nine classes, and set on each class a price according as the demand has been greater or less for pearls during the year; when these prices have been set on them, they make the allotments and shares. Then the ill-formed pearls are sold at a sufficient moderate price; the small seed-pearls are left on the sea-side and the country-people come in the spring and sift the sand for them and sell them for a trifle.

Hence the pearls and seed are sent to all parts of the world. This is all I know of this fishery. But I must not forgot to add that pieces of *amber* of a considerable size are also found on this coast. Great branches of *coral* also drift ashore when the sea is high; the black kind is better and more esteemed than the red.

CEYLON PEARL FISHERIES.

(*From the Hon'ble Geo. Vane's Report, to Governor Sir Henry Ward, 28th February*, 1863.)

Pearl banks are believed to extend all along the N. W. Coast from Negombo to Manaar, and the charts and records contain the names and positions of 19 banks, but the larger portion of them have never yielded fisheries either to the Dutch or English Governments. The Condatchy Paar having only been fished in 1801, the Chilaw Paars in 1803 and 1815, the Kariteevo in 1832, and the Peri Paar Karrai in 1833, 1835, and 1836, so that the Cheval and Modrigam have been heretofore, as now, the sources from whence the large, although precarious, Pearl Revenues have been derived; and, judging from the results of the inspections I made in March 1862 of the entire coast and known banks between Negombo and Jaffna, I believe the general productiveness of the Cheval and Modrigam is mainly attributable to their position being within the Kariteevo shoal, a means, especially to the Modrigam, of protection from the influences of weather and currents,—causes, to which are attributed the frequent disappearance, before arriving at maturity, of beds of young oysters formed in other banks. But there may also be other causes to account for these two banks alone rearing oysters to maturity; possibly the ground is favourable for the settling of the spawn, or affords good feeding; if so, and I believe this to be another essential of these banks; then, the young oysters formed on other banks may find their way to the Cheval or Modrigam, and in this manner I believe the latter banks to have been recently supplied with a portion of the oysters now thereon, from the Kariteevo Paar, which, in October 1860, was well filled with young oysters that could not be found at the inspection of March 1862.

Notwithstanding that many long lapses have occurred between each series of fisheries, the Arippo banks have yielded very large revenues to the Dutch and English Governments; they were fished by the Dutch so far back as 1667, and with intervals gave fisheries up to 1768. This was the last under the Dutch, as a period of 28 years then passed without a fishery.

The Cheval Paar and Modrigam are (as detailed in my Inspection Reports of November 1861 and April 1862,) abundantly, I may say, enormously stocked with oysters of an age that give the almost certain prospect of arriving at maturity. The Cheval Paar yielded during 1855, 1857, 1858, and 1859, 60,000,000 oysters, the fishing for many days in 1857 being from one million to one-and-a-half million. The extent of ground then covered was very much less than the present, and consisted of three separate patches or beds ; now, an extent of ground over four miles long and one-and-a-half broad, is all fairly covered, excepting one small intervening space, and should yield, at the lowest estimate, one hundred and fifty million oysters.

The Modrigam yielded 12,000,000 of oysters at the fisheries of 1859 and 1860. The ground now covered is much larger, being over a mile square, and more abundantly stocked, and should therefore now fish some twenty millions. Thus, my estimate of the present condition of these two banks is one hundred and seventy millions of oysters. Of course, before they can be fished, natural decay will materially reduce this quantity ; but comparing their extent and stock with 1855 and 1860, I see every ground for believing, unless circumstances not now fairly to be anticipated should prevent it, that the Cheval and Modrigam will yield within the next five years one hundred millions of oysters, and at least £200.000 ; and I entertain the opinion that if these banks are judiciously fished, they will be yearly replenished by the mature oysters, and the present series may be continued (with intervals of one and two years only) without the long lapses which have hitherto occurred.

The present brood of oysters are no doubt the produce of the mature oysters of 1855 and 1857, as at the fishery of 1857 the coir cable of the guard vessel at anchor outside the then fishing ground was found to be covered with very young oysters. Seeing this future promise, I required the boats to be strictly kept to the actual fishing ground, to be most careful in their proceedings, taking only mature oysters, and throwing back all young ones, and subjected boats disobeying orders, and bringing on shore young oysters, to loss of their day's fish and future employment ; and in 1859 I only used 50 boats per day and occupied 11 days in fishing the remnant left on the bank. 100 or 150 boats would have swept the ground clear in four or five days, but such a number of boats being less under control, would necessarily have trespassed beyond the narrow limits of the real fishing ground, and disturbed, perhaps destroyed, young oysters.

Fish, snakes, and chanks destroy an enormous number of young oysters. Current and drifts of sand carry away into deep water or cover beds of oysters, but in my opinion the frequent lapse of fisheries may be mainly attributed to the system under which, years ago, the banks were fished, namely the *renting* to one or two persons the right of fishing with from 100 to 300 boats daily, with no control over the proceedings of the renter and divers, but that of restriction to certain limits and the hours of fishery. So large a number of boats were of course beyond control, and not only may they have fished beyond the proper limits of the bank, but there was no means of knowing either the quantity or quality of the oysters fished, matters that should be carefully watched and recorded as a possible means of regulating and ensuring more continuous fisheries. 100 boats a day should, in my opinion, be the maximum of any fishery, as the control of all proceedings connected with this number can be maintained. Of course, circumstances may arise in connection with a special bank that might necessitate the occasional increase of this number : but as a general rule, I consider the fishing with any larger number of boats unadvisable.

The renting of fisheries had, besides the special one to which I have alluded, many other disadvantages in the character of its monopoly, its interference with the fair legitimate earnings of the divers and boatmen, the constant disputes with the officers, the assertion of losses, the claims for remission, and the impossibility of ever satisfactorily determining them. These, and the inability of ascertaining correct, I may say, any data of the results of fisheries so conducted, induce me to express the hope, that however large a sum may be offered for the renting of a fishery, Government

will not accept it. The sum offered may exceed all expectations, and possibly what may be actually realized by two or three fisheries; but I am certain the results would be detrimental to future fisheries. I may also quote the opinion expressed in 1854 by Mr. Dyke, in reporting upon an offer to rent the fishery of 1855.

"My opinion remains unchanged. It seems to me that Government could not ever derive any peculiar advantage from the plan of renting; that it must frequently lose much by it; that the proceedings of 1835, 1836, and 1837, [1855 to 1860 may now be added] have established that fisheries can be successfully conducted without having recourse to renting, and that by the sale of the oyster, the fair value of a fishery is realized in a straightforward manner, devoid of all mystery, deception, and concealment, as purchasers have to a great extent the means of ascertaining the real value."

The renting system is the much desired object of the rich chetties, who, I believe, would now make a large pecuniary sacrifice for its re-introduction; and this was the real purport of their combinations and proceedings at the fisheries of 1857 and 1858.

There is one special subject in connection with the Pearl Banks, which I think deserves consideration and trial, and which, had the opportunity offered during my term of office, I should have given, viz., the removal or transplanting of beds of young oysters to the evidently more protected and favoured grounds of the Cheval and Modrigam Paars. That this may be done without injury to the pearl oyster, I am satisfied from the proof I have had of its tenacity of life. The practice of transplanting the edible oysters to more favoured localities is very common in England, and has of late years been most extensively and successfully carried out by the French Government in the formation of oyster grounds along different parts of the French Coasts. As an experiment, and as the most likely means of saving the oysters from the causes which have hitherto so generally befallen all other broods but those found in the Cheval and Modrigam, it is worth the trial, and should be attempted on the first favourable occasion that offers, of a healthy bed, say of one or two years old, sufficiently near to the Cheval or Modrigam, to allow of their being taken up and re-deposited the same day in water. A sufficient quantity should be left on the original ground to test their progress with those removed.

I do not entertain the opinion generally expressed as to the Pearl Banks being robbed, and the necessity for a steamer constantly to guard them. The majority of the banks are distant from 8 to 12 miles from the shore, and the land-marks by which their positions are ascertained cannot be seen from small boats; and if robberies had really been effected either by parties of Ceylon or the Coast of India, rumour would certainly have afforded actual proof, as oysters can neither be removed nor opened in a concealed manner, and the display for sale of quantities of pearls by the class of persons thus having them would have led to detection. No proof of robbery has ever been asserted or afforded; but because it is supposed to be easy of accomplishment, which I do not admit, the supposition has been received as a fact. I believe the fishermen who fish along the N. W. Coast during the N. E. monsoon do much harm to some of the banks by the use of large drag nets. This sort of fishery within the precincts of the Pearl Banks is illegal, and a party lately arrested whilst so fishing, by Mr. Worsley the Supervisor, having been punished, will, with frequent inspection of their boats and nets by the Supervisor, check such proceedings; but an amendment of the law is necessary, and also an efficient guard during the N. E. monsoon: and I consider this service can be well performed by the Schooner "Ceylon" lately obtained from England, and the former guard boat. During the S. W monsoon the Arippo Coast is a dangerous Lee-shore, near to which no vessel will venture, and nature is thus a most effectual guardian of the Pearl Banks during many months of the year. A steamer's movements might be quicker, but she cannot, as the two guard boats may, keep watch upon two points of the Coast at the same time, nor could she overtake a fishing canoe; she could bring her to, with a gun, or run her ashore, both of which the boats can do, and the latter more effectually.

The favourable season for this work is the N. E. monsoon, more particularly the month of March, and whenever there is no Pearl Fishery, the whole coast between Negombo and Manaar should again, as in 1862, be examined to see if the small bed of young oysters then found off Negombo is alive and increasing, or if the banks off Chilaw, Calpentyn, and Kariteevo give any promise. This service might be done in the fine weather of January and February by Mr. Worsley with the schooner and the English and Native divers. Owing to the fisheries of the last five years occupying the fine weather of February to April, inspections have of necessity taken place between the end of October and middle of November in the lull of weather between the monsoons; but the period is too short and too precarious for any proper inspection, and only fitted for the examination of a known bed of oysters, and the taking of a sample to test their condition, and determine when they should be fished. In 1857 I was kept by strong S. W. winds at anchor off Sillawatorre for 12 days, and during some 25 days of absence on this duty, there were only five workable, whilst in 1858 there were 18 days of such fine weather as to allow of the examination of the coast from Arippo to Tallamannar; but in 1861 there was only time to take up a sample from the Cheval Paar, a gale of wind nearly wrecking the "Pearl," indeed, but for steam power allowing her to get off the land and out to sea, such would have been the case.

It is in the work of inspections that a steamer is so necessary and useful, affording as this power does quickness and precision of movement in placing vessel and boats in the exact positions needed—a matter often unattainable by sailing craft—and now that in lieu of the heavy unmanageable native boats, the fishery establishment has boats of English build, easily pulled and towed, the work is capable of being done with greater celerity and correctness. With a steamer the Superintendent has the means of satisfying *himself* of the extent and condition of all parts of a bed of oysters, by running all over the ground buoyed off, upon which the Inspector and inspection boats may be at work, and sending down the English and Native divers. With the former he can, in light weather, by letting the vessel only drift, have the ground thoroughly examined. In March 1862 I had the diver down for above an hour at a stretch, and walking over from one to two miles of ground, thus checking entirely the reports and proceedings of the inspection party.

The proceedings of inspections are thus conducted:—The Inspector with 6 boats, each having two divers and buoys in charge of a coxswain, leave the vessel at daylight, when the sea is always calm in the N. E. monsoon, spreading themselves to the four points of the compass, and diving continually in any depth of water not exceeding 8 to 9 fathoms. If rock is found one flag is hoisted. This attracts attention, as oysters are more generally found on such ground. If oysters are found, two flags are hoisted, and a buoy is at once laid down; the other boats then work their way to this point, noting if the ground be rocky, taking down such flags when getting only on sand and placing buoys if oysters are found. The limits N. S. E. and W. are then ascertained, the Superintendent in the steamer re-examining and going all round and beyond the buoys. The age, condition, and quantity of the oysters being satisfactorily ascertained, the Inspector then lays down the exact position of the bed by the bearings of the land-marks, the most prominent on the Arippo Coast being Kodremalle Hill, Kallar Beacon, Modrigam trees, and the Doric; the two former being the most generally seen and to be relied on. Taking also the bearings of each buoy, he ascertains the extent of the bed, and lays it down on the Chart; according to the number of oysters a diver is able to bring up at a time (and the coxswain keep these particulars for the portion of the bed they work upon) the calculation is made of how many five divers with relief, constantly at work for 6 hours a day, could bring up; and the probable quantity of oysters on the bed and its out-turn is thus assumed. Of course, this estimate is always very much below the actual out-turn at a fishery, but the aid which the English diving system, employed since 1859, affords in inspections by the ability of remaining longer under water exploring the bed of the ocean, and

giving more precise and explanatory account of the extent, quantity and conditions of beds, not only tends to allow of more correct estimates on these points, but is a great and needed check upon the native divers, whose information could not always be depended upon, because, from the short time they remain under water (at most a minute a spell) their observation was very cursory, and it was believed they had reasons for not telling all they did ascertain.

When a bed of oysters is of an age to be fished, a sample of 10,000 or 12,000 is taken up, landed at once, and being most carefully counted, are placed in a large ballam or boat. The place of deposit is then secured and guarded; after 10 or 12 days, when the oyster flesh has become a mass of putrid matter, the washing takes place; sea water is then put into the ballam, and a number of coolies divested of all clothing that would allow of concealment, are ranged on each side of the ballam, watched by the peons to see that they keep their hands under water when separating and washing the oyster shell, and do not take and conceal any of the Pearls they may see or feel. The shells are well rubbed together, those having pearls adhering thereto are set apart for the pearl to be cut away, and the other shells are placed in heaps alongside each man, and when all is completed are counted, to see that none have been taken, and to ensure the correctness of the quantity upon which the estimated value of the fishery is thus based. After all the shells are removed, the water is baled out and passed through sieves and cloth to arrest any pearls that might be so taken up, and then a disgusting mass of filthy putrid matter and mud remains, amongst which you see the pearl glistening. and the excitement of looking for and collecting the large ones begins. The Superintendent's eyes must be everywhere to prevent any hands but his own picking them them ont, for the natives are most quick-sighted and equally quick-fingered. The mass of mud, sand, shells and putrid flesh is then collected in a heap at one end of the ballam, and after being cleansed by repeated washing, is laid upon cloths exposed to the sun to dry; when thoroughly dry the large pearls are picked out by hand, and the smaller ones sifted by women. During this process, every precaution is taken that no pearls are lost; every article used is washed, the and water passed through sieves of of the smallest size, and a vigilant watch kept over all the people employed, as they are adepts at seeing and concealing pearl.

When all the pearls are collected, three or four intelligent, respectable pearl dealers, who are mostly of the Moorman class, are called in to estimate their value, which is done by sizing, classing, weighing; and according to these results the valuation is assigned to each class of pearls by the market rates then ruling. I shall briefly describe these operations which occupy a long time, and needing great judgment, are causes of much discussion and frequent difference of opinion; to settle which, the dumb alphabet is frequently used under a cloth to let the Senior or Accountant of the party know and decide by such individual opinion. Each of the four has his duties, one sifts, another classes, the third weighs and the other records these results in manner shewn in the valuation paper, annexure No. 3.

Sizing or arranging the pearls into 10 different sizes from the largest to the smallest, is done by passing them successively through what are called baskets. *i.e.*, small brass sieves, said to be of 20, 30, 50, 80, 100, 200, 400, 600, 800, 1,000 holes each, though there is no certainty that all baskets really contain these exact numbers except the larger ones. All pearls are first sifted in the 20 baskets, and those retained by it are of the largest or 1st size, then those retained by the 30 are of the 2nd size, and so on, through the whole 10, and those that pass through the last size are what is called "Massie Thool," small like powder or dust. There are also shell pearls, excrescences cut from the oyster shell which are of various sizes and shapes, and not generally passed through the sieves; in fact they are mainly included in the sample, to show that all its out-turn of character, bad as well as good, is fairly exhibited for the information and consideration of the dealers and speculators.

It will be understood that each of the 10 sizes may include those of nearly every class; the 20 to 80 baskets may each have Anie, Anatharie, Kallippoo, Korowel; and this necessitates the second operation of classing—one that requires the greatest skill and judgment, and which hardly any two persons will do alike. The perfections in pearls are shape and lustre, viz., sphericity, and a silvery brightness free from any discoloration whatever; and, as the pearl has these two essentials, so do the valuers assign them to their appropriate class, namely

Anie—perfect in sphericity and lustre.

Anatharie—follower or companion, but failing somewhat in one point, either sphericity or lustre.

Masengoe—confused, imperfect, failing in both points, especially in brilliancy of colour.

Kallippo—rejected or outcast, as failing still more in both points.

Korowel—nearer or shorter a double pearl.

Peesal—mis-shapen and clustered more than two to each other.

Oadwoe—beauty.

Mandangoe—folded or bent pearls.

Kural—very mis-shapen, small.

Thool—small grains.

The pearls having been sized and classed, each class is then weighed and recorded in Kalanjie and Manjadie. The former is a brass weight, equal, it is said, to 67 grains; the manjadie is a small red berry, having the property when full sized of being all exactly of the same weight, and are reckoned as 20 to the kalanjie.

The weights being ascertained, the valuation is then fixed to each pearl or set of pearls, according to their respective sizes and classes, the inferior classes solely according to weight at market value of such pearl at so many star pagodas, *i.e*, 3½ rupees each per kalanjie; but the superior classes, *i.e.*, Anie, Anatharie, and the Vadivoe, if good, are not valued only by weight, but at so much per chew of their weight, the native pearl dealers' method of assigning the proper value by weight to a valuable article of small weight; and is, I apprehend, akin to the practice of dealers in precious stones who multiply the value per carat by the square of the weight of the article: this is rather a meagre explanation of the chew, but a fuller one would need illustration by figures.

When a fishery is to take place, notice is issued in the Government *Gazette* according to the Form Annexure No. 3 and about the middle of February the bank to be fished is buoyed off, and a sample taken up and valued, so that its out-turn may be compared with that of November, and the latest condition and prospects exhibited; it is this sample, always very much superior in weight and quality, by which the speculators are (until they have washed the purchases) guided. By the end of February, Sillawatorre,—an arid, desolate sea-coast village scarcely inhabited, but so situated as to be the exact position from which the fishery boats can daily go to and from the banks, and containing space sufficient to accommodate without interference with private rights all the needs of a fishery, and too far distant from any place for its results to be the cause of annoyance to any but those whose duties or inclinations bring them there,—is densely thronged with thousands of natives of all classes, traders, pearl merchants, divers, boat-owners, boatmen, and coolies, besides visitors, English and Native, whom curiosity may bring to see what may be fairly called a most interesting sight and a wonderful Eastern fair. Then there are the Government establishments, a few troops to guard the Treasure and prevent any raid that might be attempted upon the thousands of money and property brought to the fishery; a medical establishment, and a body of Police to keep order, and, if possible health amongst this motley assemblage of European, Tamil, Singhalese, Moormen, and the still more varied tribe of the Chetty class and caste, that flock from all parts of Ceylon and India. The largest number of arrivals take place from the 25th February, and I have noted as many as 30 to 50 boats a day coming in with the sea-breeze, in companies of 5 or 6, all fully laden with men, women, and children, and the materials for their hut; and as they passed "the Doric," the Superintendent's residence, they

would give a Yo, Ho! cheer of gratification and satisfaction as the termination of the voyage, and perhaps of recognition of their Dorie for the time being. It is wonderful, considering the long distance they come from the continent of India in open Boats and laden as they are, that no loss of life occur, or at least is heard of. By the end of February the barren sandy beach of Sillawatorre is filled with some 5,000 or 6,000 persons who have housed themselves in temporary cadjan buildings of all sorts of character, according to the means or caste of the residents. Kootto sites for the deposit and decomposition of the oysters bought at the public sales, are marked out and awarded to intending speculators; these places are placed far to the south and beyond the inhabited ground, which is to the northward; and as the prevailing winds are from the northward and eastward, the stench of the decaying oysters is carried away from all but the parties employed at the koottos, guarding, receiving and washing; but an occasional burst of strong southerly wind of course disperses the aroma over every part of the inhabited quarter. With this come flies innumerable (indeed these are incessant and trying plagues, though worse with the southerly winds), every thing, especially of eating and drinking, is covered with a black mass,—a glass of wine or water must be instantly drunk, or it is filled with them, and during this time the worst city perfumes are slight in comparison to those of the fishery; but this does not last long; and indeed it seems providentially so arranged, that the prevailing winds should aid the needs and purposes of the fishery; the land wind is fair and gentle to carry the fishing boats out to the banks, also the effluvia from the oysters from the land out to sea, thus giving to the inhabitants a somewhat sweetened period for rest; then, as the sea breeze is from the northward, it brings the boats quickly from the banks to the shore, and carries the oyster smell away from Sillawatorre.

As the boats arrive they are registered, and after the day fixed for closing the list they are examined as to size, condition, and fittings. Some are rejected as too small or badly found, but as the residue is always double the number needed, the fortunate privilege of being engaged in a fishery is determined by lottery. Selection would be difficult, certainly unlikely to give satisfaction, and would lead to other consequences, whilst the result of the lottery is borne as the consequence of fate or ill-luck. As this lottery is the first great, I may say, momentous event of the fishery, as the interests of 1,500 to 2,000 persons are concerned, the divers as well as the boat-owners and boatmen, being generally interested in particular boats, I will briefly describe the proceedings Say that 50 boats are required, and that there are 75 from various places on the Continent of India and Ceylon, the prizes would be regulated and calculated as near as possible to the proportion, and with the desire that boats from each place shall have employment; then, say there were

Killacarre boats	14,	about equal to	1-5th of the 75,	the prize would be	9
Tallamanaar ,,	13,	do.	1-6th	do.	9
Navantorre ,,	14	do.	1-5th	do.	9
Calpentyn ,,	6,	do.	1-12th	do.	4
Paumben ,,	5,	do.	1-25th	do.	2
Manaar ,,	1,	do.	... ...		1

and so on. On the day of the lottery, the Kutchery grounds are crowded with many hundreds of persons to witness the proceedings, to wish good luck to their friends, and laugh at those who are unfortunate. The Superintendent calling any set of boatmen, counts the number of blank and prize tickets into a bowl, and the tindals, shewing their register tickets, come forward to draw. The agitation, anxiety and eagerness of all are depicted in the countenance; most utter an apparent prayer or invocation, the Catholics cross themselves, and many are almost too nervous to pick up the paper; when done, it is handed to the Superintendent, who opens and declares blank or prize; and so eagerly do they watch the glance of the Superintendent at the paper, and so quick-sighted are they, that I have recognised the disappointment or joy before I gave utterance to the result. If successful they run off dancing, and are greeted by their friends; if not, they move away slowly amidst the jeers and laughter of the by-standers. The unsuccessful are however frequently afterwards employed; some get the places of boats misbehaving, and if the extra number of boats is large, two divisions of boats are employed.

Indeed, as they come from very long distances, and embark all their means in this speculation, I have always made the effort to find employment for all before the fishery closes; but those successful at the lottery have, of course, the first claim, and the good fortune of longer employ.

The crew of a boat consists of 23 persons, and is required and allowed only to have 5 diving stones; 1 tindal or steersman; 1 saman oattee who has charge of the boat; 1 thody who bales out water and cleans the boat; 10 divers, 2 for each stone; 10 munducks or divers' attendants to pull up the stone and oysters, and aid the divers.

Their remuneration for fishing up the oysters is one-fourth* of the quantity daily fished; this system and compact ensures to the Government the certainty of every possible exertion on the part of each boat, such being to their own advantage, and avoids all the consequences that might arise, if the boats were remunerated by daily pay. Indeed it is the speculative character of each day's work that induces the great exertions, and gives to all concerned the personal interest so necessary to carry on the hard and anxious work of a pearl fishery. Each boat's share is divided amongst themselves, according to old established customs, in the proportions noted in Annexures Nos. 4 and 5, which papers give the general regulations enforced at the fisheries.

The fishery is actually commenced on the first night of the boats going out to the banks, and of course creates great interest and excitement. If the night be moonlight, and if possible I have always selected such, thousands of people assemble on the beach to see the start, and give their good wishes. At about 10 o'clock, the tindals who carry on their right arm a ticket No. corresponding with that painted on the bows of each boat, assemble with crews around them, and as the Beach Master has checked each crew, they go to their boat and make the preparations of getting under weigh and into position, ready to hoist the sails and start directly the signal is given. At 12 o'clock the gun is fired, the Adappenar, the senior headman, hoists a light at the masthead and leads off. In a few minutes all the boats (on occasions above 100) are under press of sail, and the sight is indeed a very interesting and exciting one: the crews of the boats cheer, and the people on beach echo them; and the white sails following the signal light of the Adappenar's boat may be distinguished for miles out at sea. The Inspector's guard vessel anchored close to the fishery ground has a light at the maintopmast head, and in dark nights blue lights are occasionally burned to see her position. The boats reach the bank, distant, the Cheval Paar about 12 and the Modrigam about 9 miles, generally about 3 or 4 in the morning and anchor; at 6 a.m. a gun is fired by the Inspector, as the signal for the boats to get under weigh and follow the Inspector and headmen to the fishery ground allotted for each day's work. When in position, and as the sun rises and the day gets calmer and hotter, the busy hum of 2,000 to 3,000 persons hard at work is heard. As I have before noted, each boat is furnished with 5 diving stones, 3 are worked on one side, 2 on the other, suspended by a thick rope over sticks or outriggers projecting from the boat's sides in such a convenient position as to allow the diver, whilst at the surface of the water, to adjust the stone by lowering or raising it, when he rests his foot upon, or rather within a loop affixed to it; these stones are generally about 14 lb. weight, and are used to accelerate the descent; and I have seen a very celebrated but corpulent and therefore buoyant diver carrying an additional stone affixed to his waist. He then places the loop of his diving net around his neck, and being thus ready gives notice to the two munducks, the attendants in charge of the rope and line of stone and net, draws in his breath, closes his nostrils with one hand, raises his body to give force to the descent, slips his hold of the bight of the diving cord, and is rapidly carried to the bottom; reaching the bottom he leaves the stone (which the munducks instantly haul up and make fast), throws himself on the ground, along which he creeps filling his net as quickly as possible; when obliged to ascend, he jerks the *net* cord, which is instantly hauled up by the munducks, by which time the diver is also at the surface, and again holding on by the diving stone; the diving is then repeated by the first set until their number of turns is over, when they take rest and the second

* This was increased in 1881 to one-third.—COMPILERS.

five divers and munducks do the work; thus, under the excitement of expected gain, these men continue for 6 hours without flagging at this most trying and laborious exertion. When regularly at work they remain under water from 60 to 70 seconds. I have timed them 75, 80, 85, and one man 95 seconds; but I believe this to be a special, as it was the only instance I ever witnessed of a diver remaining so long under water, and that the working period is about a minute. Of course the number of oysters brought up at each dive depends upon the quantities on the ground. I have known as many as 80, but 40 to 50 is a good average; and this would give from 20,000 to 30,000 as a boat load. At the fishery of 1857, when the daily fishing was from 1 to 1½ million oysters, many boats brought 30,000, a few 40,000 a day, and some boats not half the former quantity, and if this is shewn to be the consequence of bad divers they are discontinued. At 12 or 1 o'clock, according as the sea breeze sets in and to the work done, the Inspector fires the gun to leave off diving and set sail for Sillawatorre. Soon every boat is under sail, all racing to be first in, to which is attached not only a recorded distinction which gives consideration for employment during extra days, but those also first in get sooner possession of their share of their oysters and obtain the best prices. Between 3 and 4 the boats reach the shore and discharge their load of oysters into the Government kootto, a large enclosed place within which is marked spaces bearing each boat's number. Each boat's fish is arranged into 6 separate lots, and each lot divided into 4 smaller lots, the Government officers giving over to the boatmen one of each 4 divisions, in all 6 parcels; and as the people do not know which of the 4 is likely to be assigned to them, they very carefully and fairly divide them; the other 3 of each of the 6 lots are then thrown together, counted, and removed to the sale and delivering portion of the kootto, and the boat's number affixed to each heap. By the next morning a return is furnished to the Superintendent of the separate out-turn of each boat, and the total of the preceding day's fishing. A sale is held at the Cutcherry about 12 o'clock, when the oysters are put up in lots of 1,000 with the right of taking at the price knocked down from 1,000 to 20,000 or 30,000. According to the total quantity for sale, (which is always declared at the commencement), and when there is no combination, purchases are eagerly made at the larger quantities; but when there is either a combination to lower prices, or opposition between the Chetties and Moormen, the sales are prolonged by lots of 1,000 to 2,000, and all the ingenuity of each party exercised to effect the object in view. As soon as the purchasers pay for their lots, delivery orders are issued to the officers in charge of the kootto, and until the fishery boats arrive the oysters are delivered. This goes on daily, and from the first day of fishery until the conclusion the work is incessant. A break occasionally occurs from a southerly gale or combination practices; sometimes the sea breeze coming in strong and not fair, drives the boats to leeward of Sillawatorre, and obliges them to pole for miles along shore; and they do not get in till late at night, perhaps are dropping in all night until morning. On such occasions the shore is lighted up for miles with chools to guide the boats, and guards are set to prevent the crews landing the oysters, and all the establishments are of course obliged to be in attendance. In 1857, the large quantities daily fished, and the combination on the part of the buyers, so retarded the sales, that I have been frequently kept at this work until 10 at night; indeed there are no regular hours of work, all must attend as the need requires; the occupation is incessant and laborious, and only kept up by the excitement of each day's proceedings.

Annexure No. 3. (Corrected to 1881).

GOVERNMENT ADVERTISEMENT.

Notice is hereby given that a Pearl Fishery will take place at Sillavaturai in the island of Ceylon, on or about the 20th of February, 1881, and that the bank to be fished is the north-west Cheval, estimated to contain oysters sufficient to employ 100 boats for thirty days, with average loads of 10,000 oysters each per day.

It is therefore recommended that such boat owners and divers as may wish to be employed at the said fishery should be at Sillavaturai on or

before the 15th February next, and it is notified that the first day's fishery will take place on or about the 20th of February, weather permitting.

The fishery will be conducted on account of Government, and the oysters put up to sale in such lots as may be deemed expedient.

The arrangements of the the fishery will be the same as have been usual on similar occasions.

All payments to be made in ready money in Ceylon currency.

Drafts on the Banks in Colombo or Bills on the Agents of this Government in India at ten days' sight will be taken on letters of credit being produced to warrant the drawing of such Drafts or Bills.

For the convenience of purchasers, the Treasurer at Colombo, and the different Government Agents of Provinces will be authorized to receive cash deposits from parties intending to become purchasers, and receipts of these officers will be taken in payment of any sums due on account of the fishery.

No deposit will be received for a less sum than five hundred rupees.

By His Excellency's Command,

Colonial Secretary's Office,
Colombo, 9th December, 1880.

J. DOUGLAS,
Colonial Secretary.

Statement of the valuation and produce of 16,200 oysters taken from the N.-W. Cheval in November 1880.

No.	Description.	Size in basket.	Number.	Quantity in Chevoe.	Kalangey.	Manjady.	Total. Kalangey.	Total. Manjady.	Value.	Total value.	Per Chevoe.	Per Kalangey.
									R. C.	R. C.		
1	Peesel ...	20	4	—	—	1 1/2	—	—	0 39	—	—	1½
2	Kodai ...	—	7	—	—	3	—	4 1/2	0 52½	0 91½	—	1
3	Anatharey.	30	3	1/4	—	1	—	—	8 75	—	10	
4	Kalippu ...	—	4	70/320	—	1 2/16	—	2 2/16	3 82½	12 57½	5	
5	Anie ...	50	2	16/320	—	6/16	—	—	3 50	—	20	
6	Anatharey	—	3	27/320	—	10/16	—	—	3 54	—	12	20
7	Kalippu ...	—	11	—	—	2 10/16	—	—	9 19	—	—	14
8	Koroval ...	—	12	—	—	3 6/16	—	—	8 27	—	—	4
9	Peesel ...	—	17	—	—	4 1/4	—	—	2 97½	—	—	
10	Kodai ...	—	5	—	—	1 1/4	—	12 1/2	0 5	27 52½		
11	Anie ...	80	6	45/320	—	1 1/16	—	—	11 31	—	23	
12	Anatharey.	—	5	27/320	—	3/4	—	—	3 54	—	12	
13	Kalippu ...	—	12	—	—	1 11/16	—	—	4 72	—	—	16
14	Koroval ...	—	12	—	—	1 3/4	—	—	3 6	—	—	10
15	Peesel ...	—	9	—	—	1 10/16	—	—	0 85½	—	—	3
16	Kodai ...	—	5	—	—	3/4	—	7 10/16	0 5	23 54		
17	Vadivoe excluding Madanku.	100	—	2 197/320	1	8 3/4	4	8 10/16	210 50	210 50	15	
18		200	—	1 134/320	1	8 6/16						
19		400	—	312/320	1	11 1/2						
				4 3/320								
20	Tool	600										
21		800	—	—	5	7	5	7	56 17½	56 17½	—	3
22		1000										
23	Marsietool.	—	—	—	2	13 1/2	2	13 1/2	14 4	14 4	—	1½
24	Shell Pearls	—	—	—	—	12 1/2	—	12 1/2	1 0	1 0		
						Total...	14	8 6/16	346 27			

Star Pagodas.

Star Pagodas.

JAMES DONNAN, Inspector of Pearl Banks,
M. SEEMANPILLAI, Mudaliyár, Adigar of Musali, &c.,
க. இ. ச. மரக்காயர் கபிபுமுகம்மது.
(S. I. S. MARAKAR KABEBO MOHOMEDOE.)
அக. அகமதுமுகியதீன.
க. சா. லு காதிருசாகிவு.

} Pearl Merchants.

Sillavaturai, 29th November, 1880.

Annexure No. 4.

NOTICE FOR THE GENERAL INFORMATION OF PERSONS ATTENDING THE FISHERY.

1.—Application for ground for dwelling houses, boutiques, and Kootto, to be made to the Assistant Agent of Manaar, who will grant a permit for the ground allotted: and any house or Kootto erected contrary to orders, or withour permit, will be removed.

2.—The arrangements of Police, will be made by the Assistant Agent; and it is hereby notified for general information, that the Police Establishment is intended exclusively for the protection of all persons attending the Fishery, the maintenance of good order, and the preservation of the Public Peace, that they have no concern in the management of the Fishery, or in the collection of any dues, either for Government, for Temples, or any other account; and that such employment on their part is positively prohibited.

3.—The Police, and all peons, will at all times wear their Belts and Badges. They are particularly required to be civil and gentle to all persons, and carefully to abstain from interfering with any person, except where it is necessary for the preservation of good order.

4.—No persons connected with the Establishment will be permitted to receive any present or perquisite whatever, or to engage in any manner in the speculations of the Fishery, on pain of immediate dismissal.

5.—The Boatmen, and divers, and all persons in general, are to take notice that no one is authorized to make any deduction from their shares, on account of privilege or charity oysters. All contributions they choose to make for charitable purposes will therefore be perfectly voluntary; and in the case of divers delivering oysters into the Government Koottos, it will not be permitted, even with the consent of the divers, that such contributions should be received by any one inside the Koottos. The Shark Charmer* is remunerated by Government, and is not allowed, under any pretence whatever, to receive, demand or exact oysters from the boatmen, divers, or other persons. Any violation of this rule should be immediately reported to the Superintendent.

6.—After they leave the Koottos, the divers will be at liberty to do as they please with their oysters, and if molested they should apply to the police for protection.

7.—The fishing boats will be inspected, under the immediate supervision of the Superintendent, as to their sea-worthiness, condition of sails and oars, and complement of crew. The crew of each boat will consist of 23 persons, viz:—1 Samman Oattee, 1 Tindal, 1 Thody, 10 Divers, and 10 Mundücks; and previous to the inspection of the boats, the Samman Oattee will be required to furnish a list containing the names of the above-noted persons. [Of recent years all boats that have come are employed and divided into one or two divisions to fish on alternate days.]

8.—From the boats found to be qualified, the number required will take their chance of employment by Lottery.

9.—The Tindals of the boats so selected will receive from the Cutcherry, Certificates, and a copy of the Rules for the guidance of their conduct when at sea, and on shore. And it is specially notified for general information, that those regulations will be strictly enforced, and the wilful breach of them will be dealt with as therein provided for.

10.—The tindals of all the boats employed and unemployed are to attend to the orders of the Beach-master, particularly with respect to the places where their boats are to be kept, and the mode of securing them so as to prevent interruption to the passage of other boats to and fro, and of people along the beach. Neglect of these orders on their part will subject them to be excluded from employ. No canoes are to be hauled up on the beach, except at the place assigned for them.

11.—No huts of any description are to be erected upon the beach, either for the use of the crews of boats or canoes, without special permission.

12.—It will be required that the boat's third share of the oysters fished daily, be divided according to established customs, viz:—

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* The shark charmer has since been done away with.

Samman Oattee—the oysters brought up in two divings for each stone, *i. e.*, one diving for each diver.

Tindal	do.	do.
Thody	do.	do.
2 Divers, of each stone		Two-thirds.
2 Munducks	do.	One-third.

Thodyvalle or boat-owner, the whole of the boat's share of oysters once in six days' fishing; but the share may be taken any day *after*, but not *prior* to the 3*rd day's fishing*, that may be agreed upon. Arrangements with divers to pay them by wages instead of allowing them their share of oysters, according to the established customs, are expressly forbidden.

13.—It is particularly notified, that the first day's fishing will *positively* take place on the first day in March that the weather may permit the boats to fish. It is therefore recommended to such boatowners and divers, as may wish to be employed at the fishery, that they should be at Aripo, *on* or *before* the 20*th* February.

Annexure No. 5.

INSTRUCTIONS FOR THE TINDALS AND BOATMEN OF THE DIVING BOATS IN EMPLOY.

1.—The boats will be numbered by the Beach Master, and all orders to the tindals, divers, and boatmen, respecting the boats to proceed to sea each night, and the banks to be fished on, will be communicated to them through the Beach Master, to whose orders they are to pay attention; and any wilful disobedience thereof, will subject them to discontinuance from employ.

2.—The signal to proceed to sea will be as usual,—a gun fired and beat of tom-tom.

The Adappanaar will proceed a-head with a light, and all the boats are to follow him; and on no account to take any other course, but keep as close as possible to the headmen's boats. This is not done now, as the guard vessel on the bank shews a light which can be seen 6 miles off.

3.—The signal to commence diving will be as usual, ensign hoisted to the mast-head of the Government guard vessel. This signal will be made at half-past six in the morning, and no diving is to take place until it is made. The tindals are to keep their boats within the boundary of the buoys, and the place pointed out by the Inspector as the fishing ground for the day. Boats fishing beyond these limits will be discontinued from employ.

4.—The signal to cease diving, will be a gun fired from the same vessel or the hauling down of the ansign, when all diving is immediately to cease, and the boats to return to shore.

Difficulty having been heretofore experienced in enforcing proper attention to this signal, the boatmen are warned, that notice will be taken of the numbers of the boats in which diving is continued after the signal is made, a report of which will be made to the Superintendent, who will impose a fine on the boatmen for such disobedience, or if the offence be reported, discontinue the boat from employ.

5.—The boatmen are to pay strict attention to the orders of the Superintendent of the Koottos, and of the peons, and other officers, acting under him, in respect to the business of landing and counting the oysters.

6.—Upon proof of oysters having been opened in any boat, such boat will be immediately discontinued from employ, and none of the boatmen, or divers, that may have been in it, will be allowed to enter into any other boats.

The finding of knives, sticks, or other implements, for the opening of oysters, will subject the party on whom found, and the boat to which he belongs, to discontinuance from employ; and all knives or other implements whereby oysters may be opened, and three-fourths of all pearls found concealed on the persons of the boatmen, or in the boats, will be given to the finder or informer.

7.—The crew of each boat to consist of 1 Tindal, 1 Samman Oattee, 1 Thody, 10 Divers, and 10 Munducks; the division of the boat's $\frac{1}{3}$ share of the oysters fished daily, will be according to established customs.

Samman Oattee—the oysters brought up in two divings for each stone, *i. e.*, one diving for each diver.

Tindal	do.	do.
Thody	do.	do.

2 Divers, of each stone $\frac{2}{3}$
2 Mundocks, do. $\frac{1}{3}$

Thodyvalle or boat-owner, the whole of the boat's share of oysters once in six days' fishing, but the share may be taken any day *after*, but not *prior* to the 3*rd day's* fishing, that may be agreed upon. Arrangements with divers to pay them by wages instead of allowing them their share of oysters, according to established custom, are expressly forbidden.

8.—Divers deserting from the boats in which they are engaged before the fishery is over,—tindals, and Samman Oattees extorting from the divers more than the share they are entitled to, will be subject to punishment.

9.—The boats are not to leave without the permission of the Superintendent, and they are to give notice of their wish to do so, to the Beach Master.

THE CEYLON PEARL FISHERY.

The Pearl Fishery of 1881 was one of the most successful, as the result shews, of any held for a great many years back. The net receipts (£59,868) have not been equalled since 1814. This was very much due to unusually fine weather, and the very good prices offered for the oysters. Much is also due to Capt. Donnan's and Mr. Twynam's admirable management of the Fishery, and we think some special acknowledgment ought to be made of their valuable services. Capt. Phipps, Master Attendant and Superintendent of Fisheries at Tuticorin, receives from the Indian authorities, one per cent of the results of any Pearl Oyster Fishery he may direct. Seeing that this year the divers had an increased allowance—another cause probably of the success of the Fishery—we think Capt. Donnan ought also to have special acknowledgment, and no one in the Colony would grudge a bonus of R2,000, which would be less than half of the Indian allowance.

We regret to say that there is no prospect of a Fishery for next year. There is no supply of oysters ready, and the prospects of the future will be determined in March next when a regular inspection of the coast from Chilaw to Mannar will be made.

It will be seen (from the detailed table on page 182) that out of a total of twenty-seven millions of oysters fished up, over eighteen millions were sold on Government account, and realized the very handsome sum of R598,688.

Past Fisheries.

Before however dealing with the Fishery of the year 1881 in detail, we proceed to give a complete résumé of the revenue returns from Pearl Fisheries within the British era. Between 1796 and 1837 we make use of a statement shewing the revenue and expenditure only: from 1838 onwards fuller details are given:—

(Statement of Revenue and Expenditure from 1796 to 1837 compiled by the late Mr. J. L. Siebel, Chief Clerk of the Colonial Secretary's Office, for the information of Sir Henry Ward.)

Years.	*Receipts.*	*Expenditure.*
1796	...£60000 0 0	—
1797	...110000 0 0	—
1798	...140000 0 0	—
1799	... 32063 4 6	...7188 18 0
1801	... 15022 13 8	...2200 16 0
1803	... 16315 7 6	...1057 17 6
1804	... 77020 3 10	...2347 9 0
1806	.. 41284 5 8	...1339 12 1
1808	... 84257 14 8	...1963 12 10
1809	... 27246 7 8	... 655 12 0
1814	...105187 12 5	...3634 6 0
1815	... 584 4 9	... 159 0 0
1816	... 926 11 2	... 550 0 0
1820	... 3040 19 6	... 483 0 0
1823	... No Fishery	300 0 0
1824		300 0 0
1825		... 300 0 0
1826	... No Fishery	669 0 0
1827		768 0 0
1828	... 30523 7 5¾	. 1651 2 2
1829	... 38273 14 4	...1166 1 0
1830	.. 22256 9 0½	... 926 10 0
1831	... 29336 11 8¼	...1204 11 0
1832	... 4581 0 0	...1100 19 6¼
1833	... 32089 10 11	...7550 13 4
1834	... No Fishery.	... 449 0 0
1835	... 40346 0 9	...5586 2 5¼
1836	... 25816 3 11½	...5826 4 5
1837	... 10631 4 9¾	.. 2373 19 5
Total £	946,803 8 3¾	51,752 6 8½

The following return is taken from Capt. Stewart's Account of the Pearl Fisheries, and although chiefly given in old Indian currency, it makes up a total somewhat different from the foregoing:—

Year.		*Receipts.*				*Expenditure.*		
1796	Porto Nova Pagodas	98,926	12	31		5,203	4	52
1797	do. do.	330,620	4	74		1,918	3	15
1798	do. do.	380,748	28	6		12,729	17	57
1799	Star Pagodas	94,254	16	62		32,068	25	5
1801	do. do.	37,556	31	1		5,501	44	2
1803*	Porto Nova Pagodas	43,459	29	3		2,821	15	0
1804	do. do.	190,144	27	0		5,796	12	0
1806	Rix Dollars	386,997	10	2		12,516	6	0
1808	Porto Nova Pagodas	242,086	48	0		5,643	45	0
1809	do. do.	73.173	37	0		1,759	41	40
1814	Rix Dollars	1,202,052	6	1		41,443	1	3
1815*	do.	4,858	0	3¾		Net proceeds (not given)		
1816	do.	47,361	10	1		43,275	11	2¾
1820	do.	34,753	9	0		5,520	2	2½
1828	Madras Rupees	327,550	12	2¾		15,594	10	1½
1829	do.	407,570	12	0		10,304	15	7
1830	do.	251,915	0	0		8,224	7	3⅝
1831	do.	328,758	0	0		11,293	14	5⅘
1832†	... ...	£4,581	0	0		£711	1	7¼
1833	... ...	£32,059	10	11		£7,016	0	11
1835	... ...	£40,346	0	9		£2,099	0	0
1836	... ...	£25,816	3	11½		£2,280	8	1¾
1837	... ...	£10,631	4	9¾		£1,233	9	4½

Capt. Stewart makes the total net revenue from 1799 to 1837 inclusive £524,521 14s. 2¾d., against £585,000 according to Mr. Siebel's statement.

* Fishery at Chilaw. † Off Karetivu.

Year,	No. of Oysters Fished.	Sold for Govt.	Average rate per 1,000.	Total Revenue.	Expenditure.	No. of Fishing Days.
			£ s. d.	£ s. d.	£ s. d.	
1838 to 1854	No regular Fishery	....	....	2,006 0 0	8,639 0 0	
1855	6,743,762	5,051,818	2 3 3	10,922 1 0	2,632 0 0	
1856	No Fishery	....	....	...	905 11 7	..
1857	32,453,053	24,380,308	0 16 8½	20,363 6 6	4,428 0 0	23
1858	16,484,861	12,353,049	1 19 0	24,120 0 2	4,741 16 2¼	18
1859	4,191,465	3,143,402	6 3 9	48,215 18 10	4,830 10 0	18
1860	3,644,994	2,743,467	12 17 10	36,681 12 4	3,828 0 0	14
1861	No Fishery	....	....	...	1,297 13 0	...
1862	Do	....	....	...	2,476 3 8	...
1863	11,695,794	8,779,414	5 16 0	51,017 17 5	5,019 0 0	22
From 1864 to 1869	No Fishery	...	...	...	11,415 3 9* ... 5,188 11 4†	
1870					1,666 12 2½‡	
1871					759 9 9‡	
1872	Do	...	...		523 0 0‡	,,
1873				10,119	2,208 5 9‡	
1874	1,699,669	1,275,706	7 18 0	... 18 0	2,852 7 5	
1875	...	...	...	...	793½ 12 8	15
1876	No Fishery	...	...	...	1,012 5 0	
1877	6,849,720‖	5,137,290	3 13 8½	18,952 2 0	4,389 4 1½	30
1878	No Fishery	...	...	...	4,466 14 8½	
1879	7,645,901	4,127,165	1 9 2	¶9,424 13 8	4,181 7 9	12
1880	35,238,466	25,927,229	0 15 4	20,000 0 0	8,668 2 7	33
1881	27,338,593	18,225,731	3 5 8	59,868 16 0	8,500 0 0**	47
Total	123,986,781	110,644,579	2 16 4	311691 19 11	95,422 10 3¾	

* Inspections, &c. † Naturalist. ‡ Inspections, &c. ‖ Sample 10,000.

§ A Sailing vessel was voted this year for the protection of the Pearl Banks, but it has not been bought yet; a new boiler was purchased for the steam launch.

¶ Included in this amount, are the proceeds of a number of pearls retained by Government after the Fishery and sold by the Treasurer, which realized £3,355 5 8, deducting all expense, commission, &c. ** Estimated.

It will be observed that considerable gaps—intervals with no fisheries—are experienced. But this was equally the case in the time of the Dutch, who from 1732 to 1746 had no fishery, nor again from 1768 to 1796. Within the British era of 86 years, no less than 50 years are blanks so far as Pearl Fishery receipts are concerned. But during the remaining 36, the net return in hard cash has aggregated over a million pounds sterling to the Colonial revenue. The usual mode of dividing the epochs of Fisheries is as follows :—

1st Series	1796	to	1809	yielded	...	..	... £517,481
2nd ,,	1814	,,	1820	,,	...	...	... £ 89,909
3rd ,,	1828	,,	1837	,,	...	...	... £227,132
4th ,,	1855	,,	1863	,,	...	...	... £168,470
5th ,,	1874	,,	1881	,,	...	...	... £115,000
							£1,117,992

The total expenditure against these receipts equals £147,000, and a large portion of this amount was incurred between 1864 and 1869 through the employment of a special Naturalist, Mr. Holdsworth, to report on the then unaccountable disappearance and failure of the oysters, but this gentleman added only one fact of importance to our knowledge, namely that our pearl oyster (*Meleagrina margaritifera*) differs from that of the Persian Gulf (the *Placuna placenta*),* and he made no practical suggestion of any value. Previous to his advent Master-Attendant Steuart and Dr. Kelaart had paid a good deal of attention to this subject, the latter first reporting that the pearl oyster was capable of detaching its byssus and moving from place to place. In our own time Master-Attendant Donnan as Inspector of the Pearl Banks has, through careful observation, acquired a practical experience surpassed by no living authority on the subject of Pearl Oysters and Pearl Fisheries. For some years it was supposed, and Mr. Holdsworth supported the idea, that the action of currents, carrying muddy deposits over the banks of young oysters, accounted for the lapse of Fisheries, but Captain Donnan has disproved this opinion. He says :—"In my experience I have never found the slightest trace of mud being carried over the banks. The bed of the banks remains undisturbed as evidenced by the fact of a tank, which was sunk on the banks with some young oysters in it to test their growth in 1867, having remained undisturbed to this day. The tank embedded itself about a foot in the sand, and I have had it examined every year since, and it remains the same, no further accumulation or washing of sand round it." But all the experience gained, and all we have learned about the terribly destructive action of skates and other enemies, has failed to shew us any means of turning a fitful and uncertain into a regular and continuous source of revenue. Capt. Donnan has, however, acquired much practical knowledge as to the proper age at which the oysters should be fished; he has reduced the inspection of the banks to a system; and he shews in the case of the Ceylon oyster banks the danger of waiting too long equally with that of fishing too early: the proper age being generally between the fourth and sixth year, but the oysters are liable occasionally to get detached and to disappear altogether after five years. The fishing of any one particular bank must, however, be guided by circumstances, and the results of careful inspections held twice a year: this was well shewn in the case of our last two Fisheries. The outturn of Pearls in the sample taken in November 1879, proved that the oysters were too young for fishing in the spring of 1880, but then there were such an enormous number of oysters on the bed—more than could possibly be fished in one year,—that it was decided to fish a portion of the bank during that season rather than run the risk of losing them if kept another year. The oysters fished in 1880 were 4½ years old, and 26

* Capt. Donnan has, however, seen some Persian Gulf oyster shells, between which and the Gulf of Mannar oysters he could see no difference.

millions of them only yielded one-third the amount that the remainder, 18¼ millions, kept for fishing in 1881 and consequently 5½ years at the time of fishing, gave. This, however, cannot always be taken as a criterion, for the oysters fished in 1874, 1877, and 1879, were only 4 years old, and gave better results than the oysters fished in 1880, which were six months older.

Considering the half-million of pounds sterling netted during the first 14 years of British occupation, it was no wonder though Ceylon should be regarded as an Eldorado worthy of being kept in exchange for Java by the English authorities at the peace of 1815; but alas!—possibly through over-fishing and careless management in those early days—all the fisheries since 1809 put together make up no more than an equivalent sum to that obtained by our first two Governors—the Hon. Frederick North, afterwards Earl of Guildford; and General Sir Thomas Maitland, the "King Tom" of Malta and Ionian Islands celebrity. Governor Sir Robert Brownrigg, the conqueror of the Kandyan Kingdom, received one windfall of £100,000 in 1814; and then there was a blank until, in the four closing years of Sir Edward Barnes' prolonged and brilliant administration, £120,000 was received. This good fortune continued throughout the time of Sir Robert Wilmot-Horton—one year, 1834, alone being blank—and the Pearl Fishery gave this Governor altogether £113,000 of revenue. Then came a long blank of eighteen years until the advent of the great successor of Sir Edward Barnes, and one notable aid to Sir Henry Ward's expenditure in the Colony was undoubtedly found in the £140,000 derived by him from Pearl Fisheries. But "bluff Sir Harry"—the Governor distinguished *par excellence* by the "drab hat"—knew how to invest money to advantage, and he nearly doubled his revenue by liberal judicious expenditure. A change for the worse came with Sir Charles MacCarthy, whose one windfall of £51,000 in 1863 simply went to swell Mr. Cardwell's appropriation of local revenue for so-called past-due Military contributions. It is noteworty that the yield in 1863 was the largest in any one year since 1814, until the splendid return of £59,868 came from the present year's fishery. Sir Hercules Robinson did not receive a rupee from the Pearl Fishery, and Sir Wm. Gregory only £10,140 in 1874, and about £19,000 during the year he left, which fell properly to his successor. Sir James Longden has therefore to be debited with the proceeds of four Pearl Fisheries—aggregating £108,000, against £30,000 of expenditure.

The expenditure has of recent years averaged £8,000 per annum when there is a Fishery, and less than £5,000 without Fishery expenses. The Ceylon Pearl Fishery Establishment consists of 1 Superintendent (the Government Agent for the Northern Province); 1 Inspector with an allowance of R1,000 (the Master Attandant, Colombo); 4 Coxswains of inspection boats, 16 Divers, and 16 Munducks (Divers' attandants); and 1 Steam Launch and her crew. During Inspections and Fisheries a native craft is chartered for the establishment to live in. The Inspector conducts inspections and determines when a bed should be fished, and directs the fishery of the same. The Superintendent conducts the operations of the Fishery on shore, sells the oysters, &c., but has nothing to do afloat. The divers employed during the Fishery supply their own boats, and these are arranged in squadrons, payment being made by a certain proportion of the oysters fished. The Ceylon (Arippu) Fishery usually takes place in the months of March and April, when the sea is calm and the currents least perceptible. The boats assembled are numbered and divided into two squadrons, the Red and the White, each consisting generally of 60 or 70 boats. The squadrons fish alternately. Each boat has its Tindal and Today or water bailers and a guard, five diving stones, and two divers and two Munducks to each stone. The squadron starts, usually, between 11 and 12 p.m., so as to reach the fishing ground by sunrise; the banks are about 12 to 16 miles from the shore. On their return from the banks, as the boats reach the beach, they let go their anchors opposite the Government "Kottu." When the oysters are landed they are divided into four heaps. In two hours the whole of the 75 boats are unloaded, the divers' share removed and *three-fourths* belonging to Government

left in the Kottu, piled into heaps and numbered corresponding to the number of the boat from which they were taken; the doors are locked, guards stationed, and everything is in readiness for the Kachcheri sale.

It will be observed that the prices paid for the oysters differs greatly in different years. Thus, less than three millions of oysters in 1860 yielded three times the amount that 26 millions did during 1880! The average price realized (£12 17s. per 1,000) in 1860 was however quite unprecedented. Of course a good deal depends of the age and character of the pearls, but sometimes, as in 1879, and again during last year, the native traders who assemble at Arippu from different parts of India and Ceylon combine to try and keep down the price and sometimes with partial success. The Ceylon Government derives a small amount—a few thousands of rupees—annually from a fishery in the Tambalagam lake near Trincomalee, but the oyster in this case (the *Placuna placenta* of naturalists, the same as that said to be found in the Persian Gulf and China Seas) is not the true pearl oyster (*Meleagrina margaritifera*) of the Arippu pearl banks. The pearl banks close to the shore of India and Tuticorin have yielded very insignificant returns to the Indian Government, and a prolonged experiment in conserving certain banks and in the culture of the oyster by Capt. Phipps, has not been attended with success. The pearl oyster fisheries in the Persian Gulf have long been in repute: the annual yield was lately said to be £300,000 (query 300,000 rupees) in value. More recently—during the last dozen years or so—pearl fisheries have been developed on the north-west and northern coasts of the Australian continent, and "pearling," as it is called, now gives employment to considerable fleet of boats owned by colonists who employ Malays or Australian aborigines as divers. Very fine pearls both of a pale white and straw colour have been obtained off Western Australia, some of the finest pearls being extracted from the very large shells of oysters found in that quarter.* And now that both the West Australian and Queens-

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* The *Scientific American* has the following:—"Conch Pearls.—Most of our readers have doubtless frequently seen and admired the delicately tinted, pinkfaced shells which are extensively used for bordering garden-walks and other ornamental purposes; but few probably are aware that in the conch which inhabits this shell is occasionally found a very lovely gem, known to lapidaries as the conch pearl. When perfect, the pearl is either round or egg-shaped and somewhat larger than a pea, of a beautiful rose colour, and watered; that is, presenting, when held to the light, the sheeny, wavy appearance of watered silk. It is, however, a very rare circumstance to find a pearl which possesses all the requirements that constitute a perfect gem, and when such does happen it proves an exceedingly valuable prize to its fortunate finder. Pink is the most common and only desirable colour, although white, yellow, and brown pearls are occassionally found. Even among the pink ones there is usually some defect which mars their beauty and materially injures them; some are very irregular in shape and covered apparently with knobs or protuberances; others are too small, while many lack the watering, which gives them their great value and chief beauty. The conch abounds in the waters of the Bahamas, and thousands of them are annually obtained and destroyed for their shells, which form quite an article of commerce, but in not one conch in a thousand is a pearl found. When this is taken into account, and the other fact, that not more than one in twenty of pearls found turns out to be perfect, it will at once be seen that a good conch pearl will always be a rare and costly gem. In fact, their value within the last few years has almost doubled, and the demand for them is steadily increasing. Most of the conch pearls found in the Bahamas are exported to London, where they are readily sold."—During a visit we paid to Perth, Western Australia, in 1875, we saw very large pearls cleverly cut out of the inside of shells (specimens of which we have placed in the Ceylon Museum), but they were not equal in quality to the Ceylon pearls.—Compilers.

land authorities have become interested in these Fisheries, we should most strongly advise them to get such practical reports on the best mode of conserving the available banks and arranging for systematic Fisheries as the Ceylon Inspector of Pearl Fisheries, Captain Donnan, for instance, could so well furnish. They ought to take warning by our Ceylon experience of the danger of careless and presistent over-fishing. But the principal trade off the Australian Coast is in exporting the shells to Europe, to be worked up for "mother-o'-pearl" purposes. During the present "pearling" season, it is reported that two or three boats have secured as much as 30 tons of shells each. Shells from the Ceylon Fishery have also of recent years been consigned to Europe, the demand being very much for Continental gaols, where the prisoners are employed manufacturing buttons, &c., out of the nacre, but the trade has not proved profitable, and is now given up. The latest London Market Report (May 26th 1881) on sales of Pearl Shells is as follows :—"At the sales held on the 10th inst. a fair general supply was offered and with a steady demand, a good portion was sold at nearly former prices generally, but small shells were again rather cheaper. Bombay—Of 135 packages offered, 80 sold at about last sales' rates : medium to bold £5 to £5 2s 6d ; 2 cases fine color £5 17s 6d ; small medium clean £5 5s to £5 10s ; chicken fine color clean £5 5s to £5 12s 6d ; oyster and thin part broken 80s to 95s ; blistered pickings 35s to 46s per cwt. Zanzibar—35 packages sold at previous prices : good medium to bold 57s 6d to 62s 6d ; small medium 47s 6d ; oyster and thin 30s to 35s. Egyptian, of 220 packages offered, 157 sold, bold at about last sales' rates, and small sizes rather cheaper : medium to bold 95s to 102s 6d ; dull yellowish 87s 6d ; small medium clean £5 2s 6d to £5 7s 6d ; chicken £5 5s to £5 7s 6d ; chicken and small medium dull color 92s 6d to 97s 6d ; oyster 90s to 100s ; broken pieces 45s to 75s ; dead and blistered pickings 19s to 30s per cwt. Mussel, again in large supply and good demand, of 1,500 packages offered, 866 sold at about previous rates : good to fine bold 53s to 71s ; fair sorts medium to bold 42s to 57s 6d ; do. small to medium 30s to 35s ; do. small and thin 21s to 29s 6d per cwt. Next sales 5th July "—As much as £28,268 worth of "precious stones and pearls" were exported from Ceylon during 1878, about £6,000 worth in 1879, and £4,500 in 1880.

The Fishery of 1881.

In view of the increase this year from one-fourth to one-third as the share of boatmen and divers of the oysters fished, the receipts of the latter must have been very satisfactory, equal in aggregate value to at least one-half of the Government revenue. Capt. Donnan agrees with us that the divers, boat-owners, &c., got quite R300,000 (£30,000) out of the last fishery in something like the following proportions :—

200	boat-owners	at R250	each	R50,000
600	boatmen	,, 30	,, ...	18,000
1,000	divers	,, 160	,, ...	160,000
1,000	munducks	,, 72	,, ...	72,000
				R300,000

These returns for 50 days' work must have been considered very satisfactory by those concerned. The oysters fished in 1881 were valued in Nov. 1879 at R6·43 per thousand, and in Nov. 1880 at R21·37 per thousand ; nearly 3½-fold increase in the 12 months. This, together with much greater competition at the recent fishery accounts for the prices realized as compared with the fishery of 1880.

It is quite true that the oysters of 1874, 1877 and 1879 were younger than those of 1880, and yet fetched better prices. The oysters of last year and this year's fishery have been a puzzle to Capt. Donnan from first to last, and he is now led to believe that there are two kinds of oysters that breed on our beds, one coming to maturity sooner than the other, and this may probably account for some of the mistakes made in judging of the age of oysters in former years.

A complete record of the Pearl Fishery of 1881, compiled from official returns, is as follows:—

RETURN GIVING THE NUMBER OF OYSTERS FISHED, GOVERNMENT SHARE, RATE AT WHICH SOLD, AND TOTAL AMOUNT REALIZED DURING THE FISHERY OF 1881.

Day of Fishing.	Date.	Total No. of Oysters Fished.	Government Share of Oysters.	Rates at which Sold per 1,000 Oysters.	Amount Realized.
	Mar.	No.	No.	R.	R.
1	4	482,017	321,345	22, 23 & 25	7,186
2	5	480,645	320,430	25, 26 & 27	8,059
3	6	438,651	292,434	26, 27 & 28	7,798
4	7	407,677	271,785	29 & 30	7,928
5	8	663,394	442,263	25 & 26	11,129
6	9	621,228	414,152	24, 25,26 & 27	10,257
7	10	523,335	348,890	30 & 31	10,487
8	11	951,420	634,280	31 & 32	19,687
9	12	777,600	518,400	27,28, 29 & 30	14,341
10	14	1,353,900	902,600	26 & 27	24,038
11	15	1,408,320	938,880	25 & 26	23,487
12	16	1,116,469	744,313	25, 26 & 27	19,309
13	17	1,173,645	782,430	29 & 30	22,951
14	18	1,118,784	745,856	35,36,37,39,40 41,42,43,44,45	28,887
15	21	1,242,075	828,050	35 & 36	29,108
16	22	678,262	452,175	37 & 38	1,7006
17	23	913,590	609,060	37,38,39,40,41	23,133
18	24	987,082	658,055	29 & 30	19,399
19	25	810,937	540,625	25	13,516
20	26	855,445	570,297	26,27,29&31	15,689
21	28	751,155	500,770	42, 43 & 44	21,578
22	29	639,217	426.145	36,37,38,39,40	15,636
23	30	792,060	528,040	32,33,34 & 39	17,361
24	31	585,960	390,640	35,36, 37 & 38	14,192
	April				
25	1	605,280	403,520	43, 44 & 45	17,619
26	2	795,442	530.295	44, 45 & 46	23,559
27	4	564,818	376,545	40, 41,42 & 43	15,468
28	5	770,670	513,780	33, 34 & 35	17,120
29	6	491,978	327,985	34 & 35	11,293
30	7	481,335	320,890	37 & 38	11,899
31	8	382,418	254,945	40, 41, 42 & 44	10,361
32	9	446,108	297,405	41, 42, 43, 44 47 & 48	12,430
33	11	6,915	4,610	50	230
34	12	64,997	43,331	52,53,54,55,56 57,58,59,60,62	2,352
35	13	127,095	84,730	45, 46, 47 & 48	3,908
36	14	438,278	292,185	28, 29 & 33	8,192
37	15	147,060	98,040	34, 35 & 36	3,431
38	16	240,180	160,120	39 & 40	6,268
39	18	243,158	162,105	41, 42 & 43	6,832
40	19	317,655	211,770	40 & 41	8,513
41	20	345,030	230,020	41, 42 & 43	9,474
42	21	295.650	197,100	37, 39 & 40	7,592
43	22	228,045	152,030	35 & 36	5,367
44	23	142,020	94,680	30 & 35	2,965
45	25	191,040	127,360	38,39, 40 & 42	4,880
46	26	45,473	30,315	43	1,304
47	27	195,083	130,055	40, 45, 46 & 47	5,469
47	—	27,338,596	18,225,731	R32·85	R598,688

GOLD IN CEYLON.

(From the *Ceylon Observer*, June 10, 1881.)

We have received by the English mail the following Report from Mr. J. Macdonald Cameron on the specimens of Ceylon quartz submitted to him by us during his recent visit to Colombo. The finest sample of quartz, we think, comes from Mâtale, either from Cateratenne or Kinrara estate. The Hog's-back tunnel reef is evidently well worth looking after :--

J. Ferguson, Esq,

Sir,—Agreeably to your request, I have much pleasure in stating for the information of those planters who sent specimens of the quartz outcrop, on their estates, to the *Observer* Office, for examination by me :—

1st. That of all the specimens examined, only two were fine quartz.

2nd. Only one contained pyritous material : the form of combination with which gold is most usually found associated.

3rd. The purest sample of quartz is the small and very white piece which you showed me—I don't remember from whose estate it came. The most promising one is that which I believe to have been taken from a quartz outcrop at a place known as the Hog's Back. This should be thoroughly examined as it may lead to satisfactory results. Were the estate mine I would certainly spend some money in testing the direction and extent of the reef or bed, as well as of the pyritous material.

4th. The general appearance of the quartz examined proved conclusively that the samples were not properly selected; but although with the two exceptions mentioned, I was compelled to condemn them, it by no means follows that more promising material does not exist on these estates. Samples should always be taken at the greatest possible depth ; and in the absence of free gold, from that part of the reef or bed containing the greatest amount of pyritous material.

5th : In connexion with the foregoing remarks and in conclusion, I may state that a very promising sample of Ceylon quartz was shown me by Mr. Robertson of the Oriental Banking Corporation, which, if taken from a reef or bed of satisfactory dimensions, ought to be thoroughly examined; but the most satisfactory, most promising sample of all, was one shown me by Mr. W. Ferguson as belonging to the Government Agent of the Western Province. This sample, which is nothing more or less than pure gold nuggets, varying in size from that of a pin's head to that of a No. 4 shot, was taken from the bed of the river at Ratnapura some 14 years or so ago. This is however highly important for those of you who are interested in the future development of Ceylon to know that the precious metal exists at your doors, and I ventnre to suggest that what I have now said in regard to the Hog's back outcrop, Mr. Robertson's sample, and last but not least, the Government Agent's, should not be lost sight of.

I am &c.,

J. Macdonald Cameron,

F. C. S. and Fel. Inst. Chem.,

Late Assistant Royal School of Mines South Kensington, S. W.

Laboratory, 52, Lime St., London, E. C.

The specimens of gold were those belonging to Mr. Saunders already described by us as found near Ratnapura a short time ago, and which Mr. Brough Smyth declared to be very fine gold which had not travelled far from the matrix. We are glad to learn that a trial is now being made in Ambagamuwa to test quartz reefs at a sufficient depth, some 12 to 15 feet below the surface outcrop. A similar shaft should be sunk in a favourable spot in Dolosbage.

GOLD MINING IN SOUTHERN INDIA. : PRACTICAL OBSERVATIONS

Mr. C. Rowe writes from Devalah, Wynaad, to the *Mining Journal*:—

Whatever may be the ultimate result of gold mining in the Wynaad, there is certainly much that is instructive and interesting in this gold field. Unlike on the discovery of the precious metals in Australia and California, there is not the least appearance of a rush. It may be said to be essentially the capitalist's mining field. There are no working miners, prospectors on the outcrops, with an arrastra going to grind up the prill, or choice pieces, as would have been the case on the discovery of a gold field on the Pacific. Even the mining laws which the Government has enacted, ostensibly to promote a legitimate mining industry, to encourage the coming of that class which did so much to open up Australia and California, must have a contrary effect. To take up Government lands for mining purposes, the applicant is permitted to mark off 30 acres as a mining claim, with 100 acres as adjunct, for milling and other purposes, but on the latter only surface rights are granted. The real difficulty is in the quantity of labour to be employed. To retain such right the law says the employment of 5 men per acre, or on the 30 acres 150 hands.

Alluvial and outcrop mining, however, is hardly thought of; it is the working of the many quartz veins all are looking forward so anxiously for remunerative results. That there is gold here, that it is in the quartz matrix, and that there are large outcrops of quartz on which the leading mines are located anyone who has had the opportunity of passing over the district can testify. Quartz, however, is very widely distributed in the Wynaad. Gold, it is said, has been found in places at considerable distances apart, thus encouraging the expectation that the quartz embraced in an area of 1,000 or more square miles may prove sufficiently auriferous to pay. But the principal mines are not widely distributed. They may be said to be embraced in a zone of about 25 miles long and 4 miles wide, or per Fig. 1, they are bounded on the east by the Nilgiris, on the west by the Vellery Mulla mountain range, their relative positions sectionally and within such zone, being as indicated in the above engraving.

There is not much diversity in the geology of the Wynaad gold-field. The country rock is metamorphic—a hard dense gneiss, varying slightly in texture and composition, as may be expected. Intrusive rocks are the exception. In two or three places, notably at Hamslnck Waterfall, there are what appears to be trap-like rocks; but, not unfrequently, the exceptional appearance is, perhaps, due to the varying conditions at work during the original deposition of the sedimentary matter. But, as far as has yet been observed, there are no great faults passing through the district; no upheavals, bringing rocks of opposite composition in juxtaposition; near, and even in such dislocations of strata, the principal metaliferous mines of the United States and England are usually found. In fact, it is questionable if the Wynaad veins can be called true fissure veins. Certainly, they are not similar in general character to the veins usually wrought in the two named countries; but, because it is not like any other district one has been accustomed to, it would be obviously unwise to infer, without trial, it is of less value. The Wynaad district will perhaps be found peculiarly unique.

As shown in section, the principal mines are located on or near a hill, which, in nearly all cases where outcrops are exposed, the country rock is completely disintegrated; that which was to all appearance one hard gneiss has become as soft as chalk or clay. Even in this disintegrated rock, when drifted through, the strike and dip of the strata is plainly discernible, though at times it is more confused, and in the drift-side concentric rings may be seen, perhaps implying a land side, and that boulders had been imbedded in the *debris*. Nor must it be inferred the whole hill has undergone disintegration. In the bed of every stream, and protruding out at various places, the hard gneiss rock may be observed. In the section the shaded portion is intended to show what may probably be found to be disintegrated rock.

The veins not unfrequently slope down with the side of the hill, indeed, sometimes a vein is only a few feet in from the sloping surface of the hill-side, and it causes a considerable controversy with many, if the veins will really penetrate the hard dense gneiss rock. Actual mining, however, will prove this, and it is satisfactory to know that at least two companies have started deep levels, which, when driven, must prove in their cases if the veins really go to an infinite depth or not. But should the veins fail to penetrate the very hard rock, the small angle which they make with the horizon gives to a mine located on a hill-side a large working area. The secondary hills are not unfrequently from 200 to 500 ft. high. Taking a known case where the hill is 240 ft. vertically, with vein sloping all down the hill-side, at an angle of about 20° to horizon; in such an instance the working value of the vein, above the base of the hill, is 1,200 ft., or practically the same as a mine 200 fathoms deep in depth. Indeed, with the leading mines it will not be a question of quartz, but what its auriferous value per ton, may be.

Adverting further to the vein formation, there is certainly much that is puzzling; it is not unfrequent to find huge isolated boulders of auriferous quartz, but no vein *in situ*. In not one instance only, but in several, those experts of "light and leading" have written elaborate reports, defined the dip and strike of the supposed vein, given estimates of possible returns, when the most superficial mining would have proved the supposed outcrops to be simply two or three isolated boulders. But the question arises how those boulders got there? There must be some law regulating what has been so misleading and erratic: any experience which may tend to elucidate the problem can therefore not be out of place, especially when we consider the interests in many places at stake.

The dip and strike of the veins seem to bear no relation to the dip and strike of the country rock. There is not an uptilting of strata in proximity to the veins, nor are the veins encased between parallel beds of gneiss rock, but rather, so to speak, within foliating fractures, due perhaps to shrinkage and lateral pressure at all angles to the dip, and trailing along on top of the harder rock. In fact, the veins in some places bear a strong analogy to a hard, poor coal seam on the confines of the carboniferous rocks, rolling about in places, as with coal swelling out into large blocks, then, a few feet farther on, represented only by a tiny string of quartz, but in nearly all cases embedded in a soft felspathic sand. Geologically, it is not difficult to conceive the complete erosion of hills, even to forming the great valley between the two ranges of mountains, so that the quartz being thus liberated, and very hard, have resisted disintegration, and have gravitated to levels and distances some way from their original or *in situ* position; or the prolongation of veins have had the encasing softer rock washed away, the quartz being so much more durable, have resisted disintegration, and may be found scattered about at all lower levels.

An interesting feature are the old native workings. One sees a not dissimilar method to extract the gold to that employed by the ancient miners on the moors and dales of Yorkshire—those old workings which are said to have been wrought centuries ago to extract the lead and silver contained in the veins. Those northern miners, tradition says, worked the hill-side veins by directing large quantities of water to flow down over the out-cropping mineral, forming between the hard limestone rocks great grooves sometimes hundreds of feet in length, and fifty to more, feet in depth; or that they "hushed" the vein matrix out, the old workings being still called hushes.

In the Wynaad the natives seem also to have used the erosive power of water to mine, but the geologic conditions would not permit an identical method to that in the north. Perhaps a section through the Yellembully vein will illustrate.

About six to seven miles west of Devalah are situated very large native workings. The vein crops out on the hill-top. The appearances indicate the racing of water along the vein from the west—perhaps during the monsoon—

and having had small drifts driven in under the vein (some are still to be seen) into the soft sandy ground beneath, a large portion of the up-cropping vein would be undermined when turning in the water, and properly directed against the pillars, the latter would ultimately wash away, and large masses of quartz would fall down the south hill-side, which latter has the appearances of an old burrow, so covered is it with ragged and broken pieces of quartz, stones of considerable weight to small pieces like pebbles, implying the whole to have been carefully examined. Near Devalah, on the Adelphi estate, nearly a similar system has been employed. The vein in the latter slopes down near the surface in a hollow of the hill-side. Here the natives seem also to have cut through the vein in the hollow, made holes through fractures in the vein and turned in water, for their old drifts and little shafts are still to be seen. Their most mining-like workings, however, are on what is probably the dip side of this vein, on the north-east side of this hollow over a small hill. It is at this latter point the deep shafts of the native workers are found. An engineer and myself went down one of those 70 feet deep shafts.

The natives seem to have understood the danger of taking out the vein at the shaft bottom. They lift it entire at this point, and drove off in the country ground, then cross-cutted to the vein again. We went into this drift and cross-cutted a small distance, but further progress was obstructed by fallen *débris*.

Another native working which has attracted considerable notice is that of the Skull Reef, and on the extension of which below another on working has been driven the often-quoted Wright's Level. The vein at these places is 12 to 15 ft. wide, and as the quartz is quite hard the old workings have not wholly collapsed, so that one is able to see the magnitude of their mining operations.

Skull workings referred to are also not unlike those shown, being simply a hole cut through the vein. All along this outcrop small shafts are numerous, indicating in their way considerable mining having been wrought.

Still extensive native workings should be understood. When compared with the abandoned diggings of California they appear small; compared with the ancient workings of Cornwall or those found in the lead districts in the north of England, the Wynaad workings take only a minor place.

There are many peculiarities here to which but little thought is given in England or the United States notably the labour and climatic influences. Although it is said coolie labour may be obtained in unlimited quantities, there are times when its scarcity will act detrimentally to mining industry. It may, perhaps, be taken as an axiom that to mine successfully the labour and appliances must be efficient and constant. At the present labour is very scarce and not to be obtained it is said for a few weeks yet. This exodus is said to be due to feasts and the unhealthy condition of the Wynaad; still, although many suffer from fever, European and native, there is a goodly sprinkling of both classes who have thus far suffered no inconvenience from climatic influences. It is, undoubtedly, a matter of considerable importance, and will require serious thought. Those mines which the newspapers say are about making immediate returns in gold must seriously feel the want of labour. Indeed it is a question if Chinese labour would not pay to introduce, labour that would be constant for at least one, two, or even three years' contract. One harassing feature now is if a gang of coolies are taught to perform the work in hand, the week following their places have to be filled by another gang. Certainly this is a matter that will in time correct itself—relays of coolies are constantly coming and going—still when the stoping out the roofs of the drifts when large quantities of rock is being mined, it will be necessary to have such labour, both European and native, who understand their work. Appearances indicate that the ground will require being efficiently and securely timbered, or the heavy rains during a monsoon may result in serious consequences to mining development.

Devalah, Wynaad, April 20.

[The difficulty about a steady and constant supply of labour felt in the Wynaad, curiously enough would not apply to Ceylon, and our climate is also a safe one.—COMPILERS.]

GOLD IN THE KURUNEGALA DISTRICT.

Mudaliyar Jayetilleke of Kurunegala has forwarded to us some interesting specimens of quartz and plumbago streaked with auriferous-looking substances. He writes as follows:—

"I send you per train some quartz picked up from different places in the district. I believe the glittering stuff adhering to them is mica. I simply send these to you to ascertain if the quartz I am sending is of the proper sort wherein I am to search for the real thing. I have been guided by the piece of quartz with gold you gave me; and what is more, I have shewn it to hundreds of people here, without telling them where it was got from, and I hear a good many are going about searching for gold. I wish them success. 18th June 1881."

The streak of green glittering matter in the plumbago is copper, while the quartz is freely mixed with pyrites, but of a very promising character, and in one instance Mr. A. C. Dixon thinks it must be auriferous. One mode of distinguishing between iron pyrites and gold in quartz is the tarnished look which comes over the former, but a good lens is required to distinguish this clearly. Mr. Dixon has himself found the evidences of gold in the Kurunegala district, some miles along the Dambulla road. It is this gentleman's belief that the reef which crops out in the Dolosbage district runs along by Rambukkana through the Kurunegala district. Further exploration is required.

THE CEYLON PRESENT OF PEARLS TO THE PRINCESS ROYAL.

(From the *Colombo Observer*, Feb. 17, 1859.)

Pakier Tamby's gold and jewelled box, surmounted by an elephant, is, after all, to form the main portion of the present to the Princess Royal. A pair of rich pearl bracelets is to be added. The old jeweller told us last evening that he looked more to the honour than to the profit of the transaction—intimating that he had parted with the box below its value. But then, when the Queen and Princess ask "Who made this box?" the reply will be "Pakier Tamby of Ceylon!—the same, whose workmanship, exhibited at Paris, received *honorable mention.*" And so, he says, his old age will be crowned with honour.

ACKNOWLEDGMENT OF THE PRESENT.

(From the *Colombo Observer*, June 23rd.)

We have received the following for publication:—

The Governor has received the following most gracious Letter from Her Royal Highness, the Princess Frederick William of Prussia, and has much gratification in communicating Her Royal Highness's sentiments and thanks, to all, who took part in the offering recently presented.

Pavilion, Kandy, June 20th, 1859.

BERLIN, May 11th, 1859.

SIR,—I am commanded to inform Your Excellency, that Her Royal Highness the Princess Frederick William of Prussia, Princess Royal of Great Britain and Ireland, has had great satisfaction in receiving the magnificent presents forwarded by you for her acceptance on behalf of the Colony of Ceylon. Being the work of native artists, Her Royal Highness highly admired them for their taste and richness, and they are to Her Royal Highness objects of the greatest interest and curiosity. But they have, and ever will have, the greatest value in the Princess's eyes as a token of the affection and attachment which prevail, not only among the British residents, but among the native population of your Island, towards the person of Her August

Mother, and which are in such a kind manner extended to herself. Her Royal Highness feels truly touched by so gratifying an expression of the tie of sympathy connecting her with a distant possession of the British Crown, and I am to request Your Excellency to accept for yourself, and to convey to all those who have contributed to, and co-operated in the preparation of this offering, the warmest and most heartfelt thanks of Her Royal Highness. I am at the same time commanded to inform Your Excellency, that Her Royal Highness has worn the bracelets, which have been much admired, and has placed one casket on Her table, and sent the other to a jeweller's in this town, to be exhibited.

I have the honor to be, sir, Your Excellency's most obedient servant,

(Signed) E. De Stockmar,

Private Secretary to H. R. H.

To His Excellency, Sir Henry G. Ward, K. G. C. M. G., Governor of Ceylon.

"GOLD IN CEYLON":—THE LATEST REPORT.

REPORT ON QUARTZ REEF ON AMBLAKANDA ESTATE, DOLOSBAGE.

There are two prominent quartz reefs crossing this estate striking N. 20° W., and having a dip of from 70° to 80° to the W. This strike nearly coincides with the auriferous reefs of South India, the geological age of which is contemporaneous with the hill districts of Ceylon.

I traversed the principal reef from the Ingurugalla boundary to the opposite limit of the estate in the ravine near the store, as well as the greater portion of a parallel reef. I had a few blasts put in several places which were much weathered, in order to determine the nature of the quartz below, and eventually selected two places which I thought advisable to examine. The *one* was in the ravine near the store which had to be abandoned on account of water. Most attention has been paid to the main reef standing out prominently forming a ridge, about centrally situated on the estate. In this ridge a large cutting has been made across the reef which is over 20 feet broad to a depth of over 12 feet. As the pit deepens the quartz becomes more compact in texture, and contains iron pyrites as well as magnetite and limestone. It is also slightly chloritic, due to the presence of chlorite. In some parts it is laminated with hornblende and felspar, and veins of micaceous clay are met with. A large portion of the quartz is cavernous. Towards the centre of the reefs the quartz is very compact, and I think extends to a great depth.

I have selected specimens of the rock from time to time and tested the samples. Near the surface no trace of gold was evident, but deeper down I met with slight traces, and the samples last taken furnish slightly better results—not more however than 4 grains to the ton, which is a very small proportion.

I am inclined to think that on further examination of this reef in its *extension* which is considerable, and probably even in Amblakanda, that gold will be met with in much larger quantity. The reef is well defined for a long distance to the North and South, probably the same as that met with on Mount Jean.

The time occupied in blasting has been long, and the depth to which the pit has been carried has but barely reached the limit I intended. The work is now stopped on account of the rains.

Alexander Campbell Dixon,

F.C.S., B. Sc. Honors London University.

Colombo, 23rd June 1881.

[June 25th :—It is likely that Mr. W. Evans, a practical Gold Miner, will be engaged to follow up Mr. Dixon's exploration in Dolosbage and Ambagamuwa.—Compilers.]

Ferguson, Alastair Mackenzie
All about gold, gems, and pearls in Ceylon